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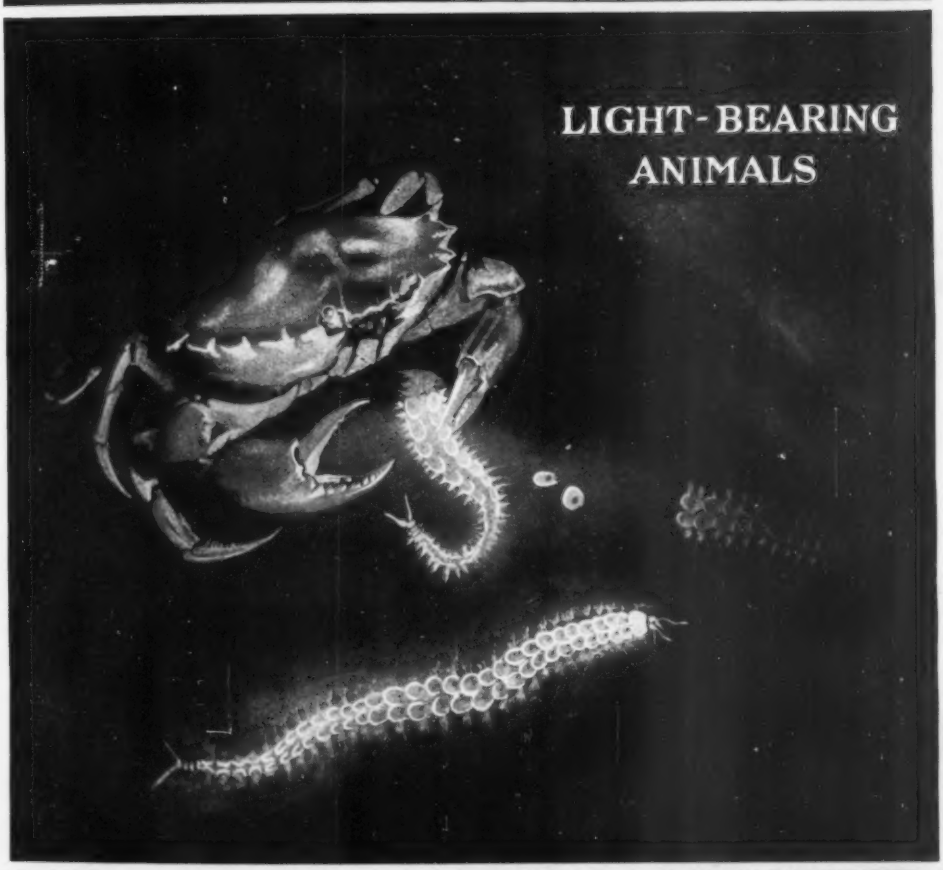
# NATURAL HISTORY




## JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

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A PHENOMENON OF THE SEA BOTTOM

A polynoid worm has been seized by a crab and snipped in two. Retained in the claw of the crab is the posterior portion, which is the less useful to the worm. It is wriggling and luminescing, thus engaging the crab's attention and enabling the anterior portion to crawl away quietly and inconspicuously. Two luminescent scales have become detached from the posterior end of the worm and appear as bright oval patches in the picture. Drawing by R. Bruce Horsfall, from descriptions by Ulric Dahlgren; originally published in the *Journal of the Franklin Institute*

# NATURAL HISTORY

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## PHOSPHORESCENT ANIMALS AND PLANTS

BY

ULRIC DAHLGREN*

HOW many of us have observed the sparkling of the fireflies over field or meadow or among the trees on a summer evening, or the glowing and scintillation of the sea in the wake of a vessel or rowboat at night as the boat cut through the water? Perhaps all who read this have done so, while a fewer number have observed the "fox fire" in rotten wood in the forest, have seen the glowworm steadily shining in the grass, or have even been made aware of the light that sometimes comes from dead fish on the beach or wharf even when these fish have been "salted down" preparatory to drying.

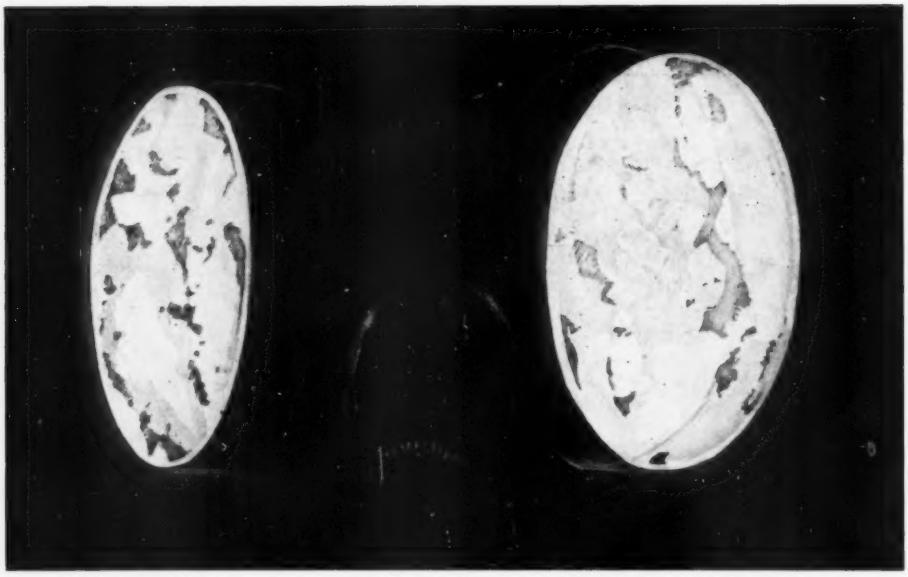
Practically all of us, however, are still unaware of the vast number and variety of animals and plants that can emit light. Only a very few travelers, scientists, and occasional observers have seen the light that comes from very many species of bacteria, fungi, jellyfishes, starfishes, worms, mollusks, crustaceans, tunicates, and fishes.

There is good reason for this pardonable ignorance. Hundreds of intelligent observers, even professional zoölogists, have captured and studied these various interesting forms in the daytime and their light has passed unobserved or has been masked by the brighter light of the sun. It is not natural or easy for people to leave their cosy homes, tents, or cabins in the night to go out and capture the smaller kinds of sea life, and even when they do so, the presence of firelight, torch, or lantern is almost as apt as is daylight itself to conceal the light of the luminous forms. It takes a special, well-directed effort to make such captures, an effort that is sometimes hard and disagreeable, as well as expensive, and one that is made only by the professional scientist or very eager amateur in search of this especial phenomenon. Again, a very large number of the most interesting of these organisms live deep in the waters of the ocean, on bottoms or under stones at depths of from fifty to thousands of feet. In order to see some of these forms in action one must have large, expensively equipped vessels with dredges and skilled crews, and must dredge night after night for long periods.

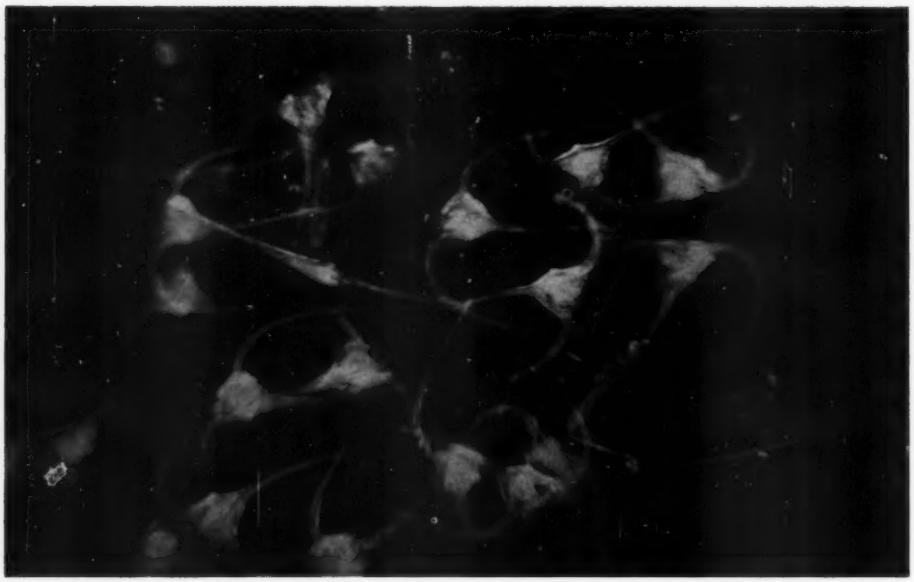
The writer proposes to present in this article illustrations of some of the most interesting and typical of these creatures depicted by artists from life or from descriptions, to point out some of the simpler features of the structures by means of which they use the light produced, and to explain some of the important facts of the fundamental chemistry by which the light is generated.

First, it must be explained that all of this light is produced by the oxidation or burning of a substance named "luciferin," that has been secreted in the living flesh or protoplasm of the organism's body cells. This substance, once so secreted, is no longer living material but is a product which may be used at once or may be stored, either in the living cell or in internal reservoirs, until it is needed to produce the light either in the living cells, in cavities of the body, or outside the animal in the surrounding water or

*Professor of Biology, Princeton University, and Director of the Harpswell Laboratory.



Even certain bacteria are luminous. The picture, which is derived from Molisch, shows two agar plates on which colonies consisting of millions of these microscopic light-producing organisms are gathered. So strong was their combined luminescence that it made possible the photographing of the skull shown between them



A common form of marine dinoflagellate found on the Atlantic coast is *Ceratium tripos*. From a photograph that appeared in the *Journal of the Franklin Institute*

air. Secondly, while the luciferin alone will oxidize without showing any light, it requires the presence of a second substance, also secreted by the animal's body and called "luciferase," in order that its chemical combination with oxygen shall produce the light. Strange to say, only very little, almost no heat is generated by this oxidation. In nearly every case the light amounts to more than 99 per cent of the energy released while only a fraction of 1 per cent of heat appears.

Even among the lowest, but not physiologically the simplest, of living organisms, the bacteria, we find some species that can produce light. Such bacteria live mostly, almost exclusively, in the sea and more than fifty species have been described by investigators. Practically *any* single gallon of water that one draws from the ocean contains one or more of them and they are present in larger numbers in the slime on the surfaces and in the various body cavities of almost all animals that live in salt water. But although these generally distributed individuals are in normal health and are multiplying and absorbing food, they do not produce light and shine under circumstances such as these. It is only when they are suddenly given a supply of rich food by being placed, for instance, on the dead body of a fish or other animal, and have multiplied into masses containing millions of individuals, that they begin to emit the beautiful greenish yellow or greenish blue light that is characteristic of them. The upper figure on p. 6 shows two agar plates on which colonies of these microscopic creatures have formed masses of a transparent, jelly-like slime. Sufficient light was present to photograph the old skull placed between them.

At this stage in their history every individual is secreting luciferin and burning it, *inside* of the body flesh as fast as it is secreted, to produce the wonderful light. When the food becomes too old through decay and when the other secretions of their bodies have poisoned the mass, the light ceases, and then the bacteria become scattered in the water, are killed by drying, or become attached to some living animals, passing out of cognizance until some of their descendants find by a happy accident another favorable supply of suitable food and the phenomenon repeats itself.

The light is continuous as long as the favorable conditions last and almost never are the bacteria the source of the sea light that we see in the wake of a vessel or on the crests of the waves in rough weather. Among the several organisms that do make this familiar ocean light are other forms of one-celled, microscopic creatures. These are the marine dinoflagellate protozoa, which are also claimed by botanists under the name of the Peridinidæ.

There are a great many species of these organisms. Those members of the group that live in fresh water do not emit light, but most of those that live in the sea have the power of shining. The marine species float on the surface and are found in all seas. *Noctiluca*, a small, rounded or heart-shaped creature, lives on the surface in such numbers in favorable seasons that the sea is colored a brownish red or rusty color. *Ceratium tripos*, another kind, triangular in shape with three long, curved projections like horns, is equally abundant, but is so clear and transparent that its presence is not indicated to the eye. Various other similarly shaped species are found. One variety, found in the lower ends of Chesapeake and Delaware bays, grows in long chains and, like *Noctiluca*, gives a reddish color to the water.

The light of these creatures is produced by the same substance, luciferin, secreted in the same way in their flesh as in the bacteria, but the method of its use after being secreted differs in one important particular. The luciferin is not secreted all through the body but only at more or less numerous points and is stored at these points in tiny

granules, to be used at the proper time. That time is at night and then only when the organism is stimulated by physical or chemical means. The bacterium goes on shining continuously day and night, light or dark. The light-giving dinoflagellate gives a bright spark of light only when stimulated to do so through the stirring of the water by an oar, or by a wave break, or when some unpleasant chemical substance like alcohol or ammonia, is thrown into the water. *Ceratium* gives a short, sharp flash lasting only a fraction of a second. *Noctiluca* gives a slower glow differing in degree according to the strength of the stimulus. The lower figure, p. 6 shows one of these forms, *Ceratium*, photographed by its own light.

When fresh, this fungus, *Clitocybe illudens*, shows phosphorescence at night. The fungus is normally a rich saffron yellow, although sometimes old plants become a sordid brown. (From *Mushrooms* by Atkinson)

Turning now to the only true plants that give light of this kind, we find that a few species of fungi of the toadstool forms are able to shine. In some it is the mycelium, the plant's main underground body, a thin network of branching strands, that can do so, in others it is only the sporophore, or familiar toadstool structure, that has this potency, while in the case of a few fungi all parts can shine. Here we find that the light comes from all the cells of a part of the body and that, as in the bacteria, the light is a continuous glow, the luciferin being burned as fast as it is secreted, night or day, stimulus or no stimulus. Sometimes the plant glows for all of its lifetime, as in some mycelia; in other cases, as in *Clitocybe illudens*, the sporophore glows for only a few days early in its short life. The accompanying figure shows *Clitocybe illudens*, a species of American fungus with glowing sporophore.

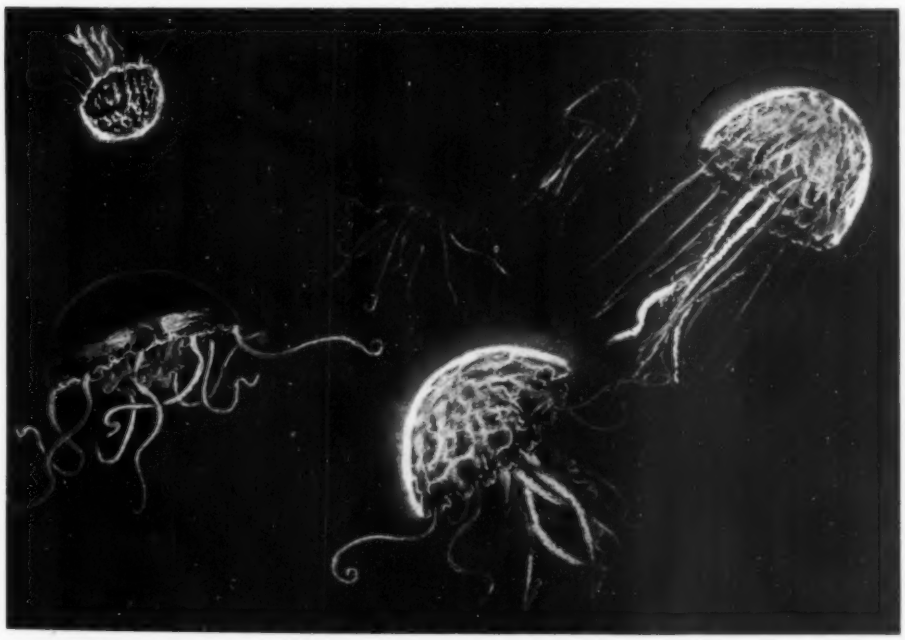
Passing to the cœlenterate animals, or jellyfishes and polyps, we find the power of lighting very widespread. A great many jellyfishes and hydroids can glow, while a large number cannot do so at all. The forms that live near the coast are usually the ones that cannot, while the deep-sea forms living in great depths and the pelagic, or open-sea, kinds that live on the surface far from land are the species that show the power best.

These animals do not glow all over their bodies but only from certain epithelial cells, which may be scattered all over the surface or be collected more or less into groups or organs. Each of these light cells secretes luciferin in tiny granules and when the creature is stimulated, usually by some mechanical means, the luciferin is ejected into the surrounding water, doubtlessly accompanied by luciferase, and the lighting appears in the slime which covers the body. Thus, if one handles such a creature at night, the luminous slime comes off and shines on the hand and fingers. In the highest group of cœlenterates, the ctenophores, the power described is especially well developed and appears to be internal, but a closer study shows that it is certain of the epithelial cells lining the water canals that perform the function, which cannot, therefore, be considered to be internal. In

these same ctenophores another important principle has been discovered by close study. The presence of any bright light stops or inhibits the whole process, nor can it be resumed until the animal has rested for some time (about a half hour) in the dark. If one brings ctenophores into the laboratory dark room from sunlit waters for study, he finds that for a half hour or so no light can be seen following any stimulation. Or if a lamp is lit for a few minutes and then put out, no light can be got from the creature for a time. Below is figured a jellyfish, as it appears when lighting.

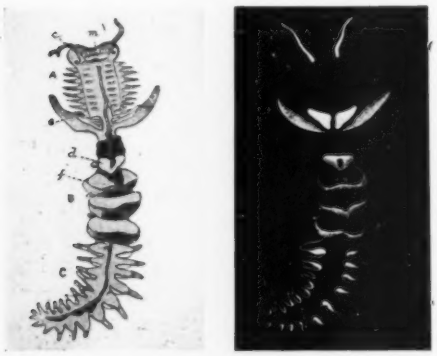
Among the echinoderms are also found a few luminous kinds. No sea urchin, common star, or holothurian has ever been seen to emit light. Some crinoids have been reported as being able to do so; many of the brittlestars are known to do so very decidedly. Like the cœlenterates they have certain enlarged, unicellular glands on the sides of the arms that secrete luciferin, and when stimulated, these throw out their contents which stick to the surface and glow quite brightly.

Passing now to the worms, we find that several of the more highly organized kinds also can luminesce, and here for the first time we see that the power resides in well differentiated organs. The simplest of these in its lighting organization is the annelid worm *Chætopterus*, a large, highly specialized form that builds a tube in the mud and sand of shallow water in all the warm sea inlets and harbors of the world. It is about eight or nine inches long, of soft texture, and cream-white in color, with some parapodia specialized into long, trowel-like appendages for plastering a hard-setting mucus used to build and repair the parchment-like tube, with other parapodia formed into large paddles to create a current through the tube, and with simple posterior segments for developing and holding the reproductive cells or sperm and eggs. Various other



A luminous jellyfish, *Pelagia noctiluca*, from the Mediterranean Sea. It is depicted above in both the lighted and the unlighted state. From a drawing by Miss E. Grace White based on descriptions by the writer; first published in the *Journal of the Franklin Institute*

queer appendages are developed on the body for unknown purposes, and the whole animal has a very queer appearance and hardly looks like a worm but rather like some very peculiar mollusk. The hollow tube in which it lives lies buried in the mud and is U-shaped, with the two open ends projecting a short distance above the surface. The tube is about fourteen to eighteen inches in length and is widest at its middle part.




Two views of the parchment worm (*Chætopterus*) after Panceri. On the right the animal is seen phosphorescing, the luminous portions of its body revealed. This worm is found along the seacoast in sandy mud, in which it excavates U-shaped tubes that serve as its dwelling place. It lines these tubes, the two ends of which are built up like protruding chimneys above the sea bottom, with a viscous substance produced by certain glands of its body. This substance hardens upon contact with salt water, taking on a parchment-like character that explains the name given its artisan. The body of the worm is divided into three main areas, indicated by the letters A, B, C in the picture on the left. The three disk-shaped segments embraced by the letter B, the first of which is indicated by an *f*, just fit the interior of the tube and constitute a pumping apparatus. As the worm rhythmically contracts, these segments act on the principle of the piston of a suction pump, causing a stream of water to pass in at one chimney and, after circulating through the tube, to pass out at the other. Through the stream of water thus set in motion many microscopic organisms on which the worm feeds are brought to it. These organisms are filtered out of the stream by the arms or wings, indicated by *e*, which, while the stream is being pumped through the tube, are arched about the hollowed cup, *d*. The mouth of the creature is indicated by *m;* the tentacles, which appear as bright, irregular lines on the luminous specimen, are indicated in the picture on the left by *c*.

In the Woods Hole Annulate Group in the Darwin Hall of the American Museum, the parchment worm is shown in its natural environment, while an enlarged model in a neighboring case brings out clearly the remarkable peculiarities of its structure

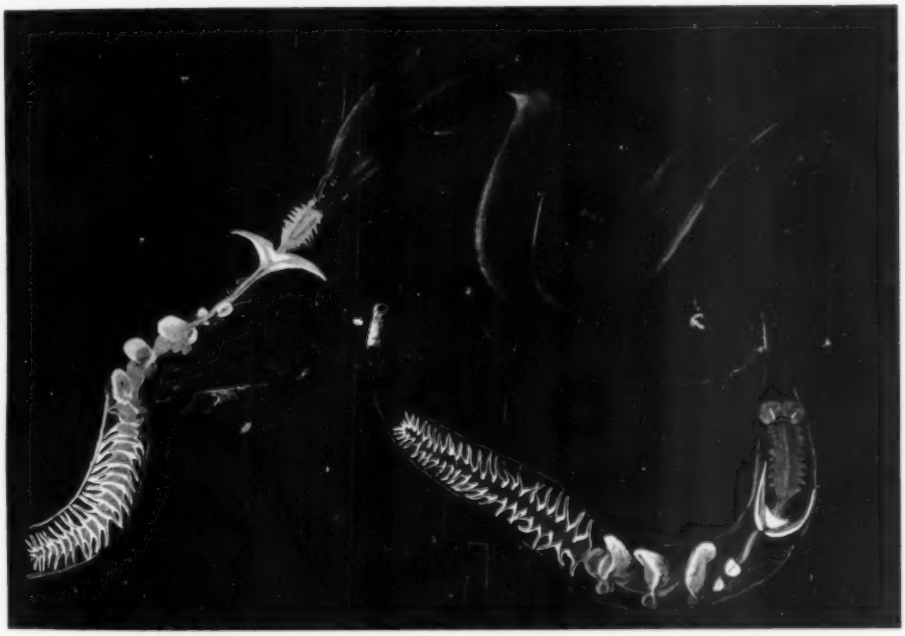
When at rest this organism is devoid of all light in the dark. But when a stimulus of any kind, either chemical or physical, is applied, it shines faintly or brightly according to the strength of that stimulus. The light begins as a series of peculiar violet or rosy glows that pass over the surface and then, with the stronger sorts of stimuli and according to the strength or vitality of the worm, ends as a bright, steady glow that may last for several minutes. This glow is very much stronger and lasts longer on certain appendages or parts of appendages than on the rest of the body.

A microscopic examination shows that, as in the cœlenterates, the light is produced by the secretion of thousands of single epithelial cells, or unicellular glands, scattered all over the animal's surface but much larger and more closely set on those parts where the light is strongest. These parts may be considered the light organs,—not very finished or highly specialized organs, but a marked step in advance. When seen in well-stained sections under the microscope, the cells look very much like those of the cœlenterates with their distal or outer ends filled with a mass of numerous, tightly packed, and round granules, which are the stored light substance.

In this case, too, as in the cœlenterates, the light appears only when the proper nerve impulse causes the cells to contract and throw few or many of these granules out into the surrounding layer of body slime, or mucus. While in the cell, they do not burn because they are kept free of oxygen. Once expelled, they rapidly oxidize and glow brightly. Two or three of these worms in a bucket half filled with fresh sea water, if irritated for a while, will discharge into the water so large a quantity of mucus mixed with luciferin that the entire amount of water will shine brightly for five minutes or

more. The burning is comparatively slow and persists for some moments in contrast to the bright, sudden flash of a warm-water ctenophore. Two pictures of one of these worms are shown, one as it appears by daylight, showing its form and structure, the other as it appears in the dark, showing the location and extent of its chief light organs, or luminous patches.

The question now arises, to what end do these worms shine? Of what use is light to them or to the bacteria, the dinoflagellate protozoa, the fungi, or the cœlenterates? The question appears hopeless unless we consider the lighting merely as a sort of active coloration just as pigments are a method of passive coloration. Why do some few bacteria secrete yellow, blue, violet, red, and other pigments? Or some dinoflagellates red and brown pigments, or some fungi other bright colors? Even the usually transparent cœlenterates secrete bright colors on the surfaces of their bodies. It may be avoiding the question, but we can refer our problem of the uses of light to the larger one of color, and we shall see, if we pursue the study far enough, that the light so often appears in an organism under the same circumstances as does color that there must be a relation between the two. For instance, most animals have their brightest and most pronounced colors on their dorsal surface, leaving the ventral surfaces to show an evident lack of color, or lighter shade of color. In a majority of the luminous creatures the light appears in the ventral position, thus serving, in the dark, to give the creature a comparatively lighter underside. The light serves to color the animal in darkness where the ordinary colors would not show at all, but it colors it in a negative way. Later we shall see that



An eel hunting *Chætopterus* at night. The worm that is being seized is in full luminescence; another worm in a neighboring tube is beginning to light, stimulated by the commotion in the water occasioned by the attack of the eel. Drawing by R. Bruce Horsfall; republished from the *Journal of the Franklin Institute*

it assumes a positive color function in some of the more highly specialized cases.

Owing to his habit of living in a tube underground, our friend *Chætopterus* is largely protected from the many animals that would otherwise be inclined to eat him. One species of little crab practically always lives in the tube with him though it never hurts him, and this crab is not known to live anywhere else. Some animals, however, do successfully attack and eat him. One is the eel, and a picture of the probable method of attack is shown on the preceding page. The worm has thrust his head up near one of the openings of his tube, and the eel, taking advantage of this position, has seized the head, tube, and all, and, breaking off the neck of the tube and discarding it, is pulling the worm out of his home. Usually the worm breaks so that the eel secures only a part of him. I have speared eels on a *Chætopterus* flat that have had in their stomachs a number of *Chætopterus* heads and even some whole worms. Although such an act of devouring has not been witnessed, the worm must certainly shine brightly while it is being eaten.

Another interesting annelid worm that lights is *Acholoe*, one of the so-called "scale worms." This animal lives on the sea bottom in moderate depths under shells and stones, and its long, slender, segmented body is covered by two rows of "scales," which are not scales at all but mushroom-shaped bits of flesh, two of them attached to each segment. The top side of each "scale" can shine, in this instance also from scattered epithelial gland cells, but the interesting feature is that if the body is cut in two in any place, whether by a pair of scissors or by a crab's claws, the anterior part will crawl quietly off while the posterior part will wriggle and shine brilliantly. If one excepts the shining, much the same is true of an earthworm. Physiologists know that if an earthworm be cut in two parts, the anterior end remains fairly quiet while the posterior part wriggles violently. The light in the case of *Acholoe* appears to share with motion a protective function in that the less useful part of the body is the more apt, through these demonstrations, to attract the attention of an attacking enemy, thereby permitting the essential part of the body to escape. Even single scales when detached will shine brilliantly. The frontispiece shows this phenomenon.

Another common little annelid worm, *Polycirrus*, seems to teach us a lesson in regard to the use of light. This annelid is short and fleshy and lives on European coasts in large numbers, crawling under the edges of seaweed-covered stones or burying itself in gravel. It protrudes its head only, which is surmounted by a thick bunch of long, slender tentacles. During the daytime these tentacles appear of a bright red or orange yellow color in different individuals while the body is a dark muddy brown. In the darkness the tentacles shine brightly, but the body always remains dark. Now let us note another and related fact of interest: if you place such a worm before a hungry fish, the latter will sometimes seize it, but will always spit it out again. If you cut off the head with its tentacles attached, the fish will seize and swallow the headless body, but always reject the head with its tentacles. The tentacles are distasteful to him and the bright red or yellow color is a warning coloration. So also is the luminosity.

Yet another annelid worm can teach us an interesting lesson. This is the tropical marine annelid *Odontosyllis*, an inhabitant, among other places, of the waters of Bermuda. The light organs of this worm are highly specialized structures developed from other specialized organs found in annelid worms, the setæ or body spines. We find setæ on the parapodia of nearly all annelids. They give the "roughness" to an earthworm or act as the poisonous barbs of some marine forms. They are made of a substance called chitin by a set of cells

developed from the epidermis and called the setigenous cells. In *Odontosyllis* certain of the ventral setigenous glands instead of secreting chitin to form setæ make granules of luciferin, while neighboring groups form luciferase. These two substances are thrown out together under the proper stimulation and illuminate in the water.

These worms live in crevices of the coral rock for nearly all of their lives. But at certain times in the summer—very exact times—they come forth to lay their eggs. The eggs and sperm are deposited on the surface of the sea and the eggs thereby become fertilized. The time for spawning has an exact relation to the time of the full moon combined with a slighter influence that may be attributed to the relation of the tide to the time of day.

Galloway gives the dates of the appearances for spawning purposes during the summer of 1904. These dates were: July 3–7 (maximum on July 4), July 29–31 (maximum on July 30), August 31. The display, as seen from the wharfs, lasted about one half hour and was as follows: Just as dusk was becoming pronounced, the females, which evidently had swam up from the depths without showing any light, suddenly began to display their glow, swimming rapidly on the surface in circles about two to three inches in diameter. Each left behind her a glow caused by the faintly luminous eggs and the much brighter luminous secretion from the light-producing glands. If the male failed to appear, the glow ceased after ten or fifteen seconds.

The male is first seen as a distant

The marine worm, *Odontosyllis*, lives for the greater part of its life in the crevices of coral rock. At certain definite times during the summer, however, it issues forth and comes to the surface of the sea. There the female, as she swims, deposits her eggs. These eggs are themselves mildly luminous, but, in addition, the female discharges from her light-producing glands a secretion that glows for from ten to fifteen seconds and apprises the male of her presence. Drawn by Miss E. Grace White after the descriptions of Galloway and Welch, Cary, Linton and others, and originally published by the *Journal of the Franklin Institute*


A marine copepod much enlarged. This little creature, when stimulated, gives off light substance from several points on its body. The position of the glands that secrete substance of this character is indicated by the letter *l*. (After Giesbrecht.)

glint of light in the deeper water and headed toward the glowing female. He comes up rapidly and when the female starts one of her short periods of shedding eggs and light substance, he darts to her and they swim together in somewhat wider circles, she scattering eggs and he sperm into the water.

Light may be evoked from either of the parent worms by the usual form of stimuli even though they have been captured after the eggs and sperm are all shed. The picture on p. 12 gives an idea of how these worms would appear from beneath if the observer, looking upward through the glass side of the aquarium, were to see them spawning.

Passing by some other interesting kinds of luminous worms, we will now consider the Crustacea, which have very curious, light-producing members. Perhaps the best known luminous forms are a few of the many hundred species of copepods, very small crustaceans that are found in both fresh and salt water. On account of their size and active movements these are often called "water fleas."

None of the fresh-water kinds can produce light. Among the salt-water species which swarm on the surface of the ocean, a few, as Professor Giesbrecht, of Naples, has shown, are able to give a tiny, bright spark at certain times of the year, probably during the breeding season.

Giesbrecht found it very difficult to prove that any particular copepod was capable of producing light or lacked this power. By pouring sea water containing the tiny animals on to a cheesecloth screen and then rapidly examining the layer of kicking, struggling creatures with a magnifying glass, he was able finally to pick out four kinds that did emit one or more tiny sparks. He put these under the microscope and was further able to see that the light came from several spots, always the same, on the body or limbs. A careful examination of these spots then showed that each was a tiny gland with an opening through which the luciferin was thrown when the animal was stimulated either mechanically or chemically. Thus he found that the copepods, or such of them as could light, produced their flash outside of their body,—a method that is not found in all of the Crustacea by any means as we shall see. One of these minute forms is shown much enlarged. The picture indicates the position of the glands that secrete the luciferin (and undoubtedly also the luciferase).

The next luminous crustacean that we will examine, a very remarkable one, illuminates in a very different way. This animal is one of the group Schizopoda, small shrimplike forms found all over the world, especially in the sea. Two principal forms occur: the Mysidæ, which usually live nearer shore and on the bottom, and the somewhat larger Euphausidæ, which are found in waters farther from the shore and tend to swim up off the bottom, sometimes near the surface. It is reported that the *Mysis* forms sometimes give light, but no definite work has been done to prove this fact or to indicate any structures that might possibly be light organs. On the other hand, we know that the Euphausidæ have some of the best developed light

organs that are known, and in studying them we will find for the first time some of the interesting accessory tissues and organs that are used to intensify, color, and direct the light, as well as to protect the other tissues from its rays.

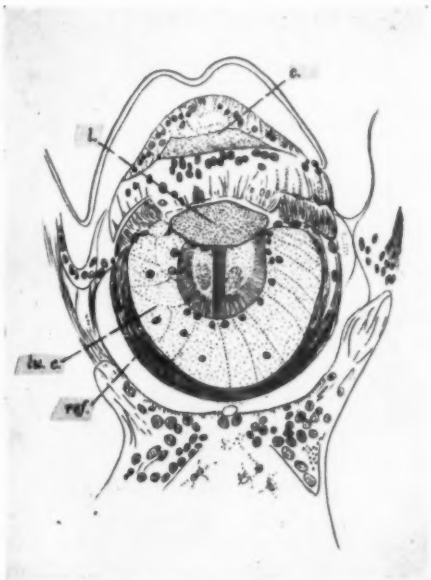
The general effect of all these accessory tissues on the appearance of the light organs is to make them resemble eyes on superficial examination. In fact, long before their true nature was recognized, these organs were described as accessory eyes by some of the best known students of the group.

There are usually ten of these organs, but they occur in lessening numbers in some of the simpler forms. Some Euphausidæ have only four or even two, and others, for instance certain species of *Stylochiron*, have none. For our purpose we will study the common species, *Nyctiphanes norvegica*, found near most shores of the North Atlantic Ocean and easily procurable for study at most biological stations.

This small shrimp has ten light organs: one on each of the two eye stalks; four on the thorax, two of which occur on each lower lateral edge; four others on the median ventral line of the abdomen. Each light organ is a round, slightly protuberant mass, and seems to be capable of a slight, rolling motion, as well as a change of position and direction due to the movements of the limbs near which it is placed.

If one examines an axial section of this organ under the microscope (see accompanying picture), many details of its structure become clear. The inner, hemispherical surface is covered outwardly by a double layer consisting of a very thin outer envelope of pigment, which naturally keeps all light from passing into the body tissues, and an inner part composed of a thick covering of reflector cells in which has been secreted some substance that reflects any light which may strike the layer. Thus the body tissues are doubly protected from light, but one naturally wonders why the pigment is present at all, if all the light is to be reflected or turned back before it gets to this layer. Still we repeatedly find this arrangement in so many different light organs of independent origin that some good reason must exist which may some day be explained by further study.

Within the concavity of the reflector comes the thick, fleshy, cup-shaped mass




Axial section of the light organ of a shrimp, *Nyctiphanes norvegica: ref.*, reflector; *lu.c.*, light cells; *l*, lens of chitin; *c*, cornea. From Dahlgren and Kepner's *Histology*. After Valentine and Cunningham

of the light cells (*lu.c*) in which the granular luciferin is secreted. These cells extend from the reflector (*ref*) to the inside of the cup in most cases, although a few of them are shorter. Their nuclei are large, round, and dark-staining, and running between the cells and through them are a number of blood capillaries, the course of which is shown by the light streaks in the drawing. The size and number of these capillaries would seem to indicate that they bear the supply of oxygen that is used to burn the luciferin when the light is emitted.

In the hollow of the cup formed by the

light cells lies the peculiar mass of long, thin rods the purpose or use of which remains up to the present a puzzle. Most of them are arranged in a radial fashion, while two smaller masses lie horizontally within the cup. These are indicated in the drawing, where they are seen in cross-section, by two oval patches of dots. Much interesting work remains to be done on these in order to determine their function.

Immediately in front of the rod-mass lies the chitinous lens (*l*) the function of which is clear from the position, shape, transparency, and refractive qualities in the living animal. This lens is fixed in form and is immovable in position. The wide, flat, and circular cell in front of it would appear to be the cell that forms and supports it.

In front of this cell and closely adhering to it is the wide, flat, and somewhat thick cellular lens, or outer lens, the use of which has been guessed at, and probably correctly, by the presence of a ring-shaped mass of what is probably muscle tissue. This mass is in a position to thin out the outer edge of the outer lens and thus alter its focus. It has been called by Trojan the lamella; work must be done on its structure and chemical reactions as well as observations made on its actual behavior during life to prove that it really is muscle tissue.

Next comes a wide blood space, always filled with the blood plasma, and outermost of all the cornea (*c*), made up of a somewhat specialized area of the easily understood hypodermis with its usual cuticle.

Here we have a remarkably complex and specialized organ with reflector and pigment layer, two lenses, and some unknown structures that can be used at the will of the animal and are so used when the creature is disturbed or stimulated. What the normal use of this organ may be in life we do not yet know,—possibly a sex attraction or to warn enemies or to find food or merely to color the ventral surface of the creature. The light is of the usual greenish yellow tinge seen in most luminous creatures. Nothing is known of its development, which should be very interesting. The light does not flash but burns for some seconds or minutes with a steady glow. It is internal, but whether it appears in the luminous cells or in the rod-mass is also not known.

Other groups of deep-sea shrimps or prawns, the Penæidea and Caridea, have much simpler light organs of dermal origin and produce their blue or violet light by internal combustion.

Still another large group of deep-sea prawns, as represented by *Heterocarpus* and *Aristeus*, have a totally different method of lighting. They possess a large number of glands opening by fine ducts into the stream of respiratory water, so that, when the animal is stimulated, the luciferin is ejected into this stream and is thus blown out in front of the organism in clouds of light. Mr. Welch has described to me a species in which the clouds of light material assume the form of rings much like the smoke rings blown out into the air by a human smoker (see p. 21).

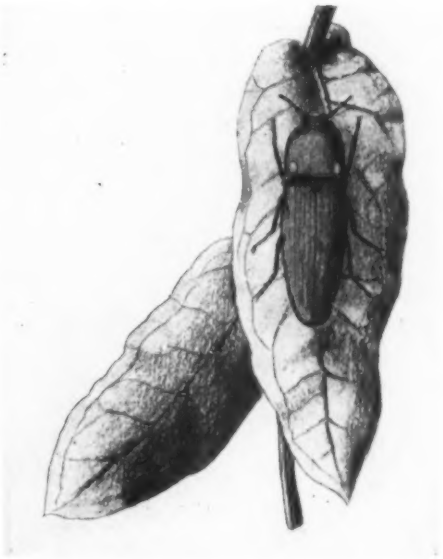
Perhaps one of the most interesting of all the light-giving Crustacea is the tiny ostracod, *Cypridina hilgendorfii*, that is found in Japanese waters. Its Japanese name translated into English signifies "marine firefly" and when disturbed it gives out powerful, if small, flashes of a bright, blue light with no trace of green or yellow as in most forms. The light substance comes from unicellular glands in the body that open on the upper lip. An important point here is that there are several kinds of these glands, and that we can in this case distinguish the luciferin from the luciferase in the several parts of the gland. This condition is a rare one among the known luminous forms and has made *Cypridina* available for the most important chemical studies of luciferin that have yet appeared, those by Dr. E. N. Harvey.

Various other crustaceans have been dredged up out of deep water by the "Challenger," the "Valdivia," and other deep-sea expeditions, but they have not been carefully studied. One large crab had large, superficial patches of light on its lower surface.

The insects, close relatives of the crustaceans, have certain luminous members. The common occurrence of some of these insects in our fields and on our lawns are well known to man,—better perhaps than any other light-giving animals. One case of luminescence is found among the primitive insects called collembolids. Several species of these, very minute in size and living in old manure, dead leaves, and in alluvial gravel in the river valleys of our eastern and southern streams, can emit a small, short glow. In this case the light comes from all the hypodermal cells which cover the body and form the cuticle or skin. Here the luciferin appears as well-formed granules in the cells, and the method of lighting must be the same as that seen in so primitive an animal as *Noctiluca*.

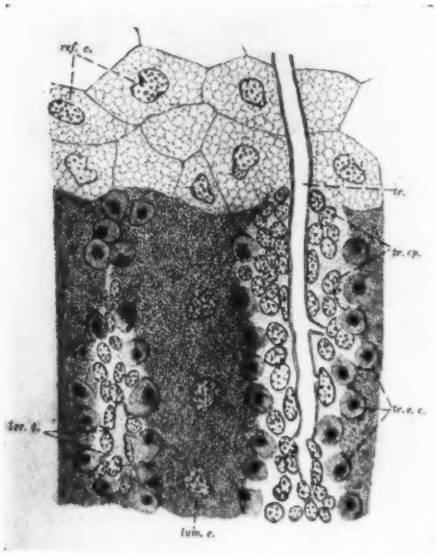
Another luminous insect is a fly found in Australia and New Zealand. Both larva and adult show a glow in the interior of the body. The glow comes from the cells that constitute the distal ends of the Malpighian tubules, which are, in fact, the fly's kidneys,—a remarkable modification that shows us from what diverse sources the light cells can be derived.

The best known insects are the fireflies and glowworms of our own and practically all other countries, and the fire beetles, or cucujos, of the tropics.[1] In all of these insects, which belong to two families of beetles, the Lampyridæ and the Elateridæ, it seems that the light cells are derived from modified fat bodies,—one of the few cases where mesodermal elements have been used for this purpose. Their structure shows the common principle of a layer of light cells near and next to the integument, a transparent cuticle at that point, and a layer of reflector cells filled with crystals of calcium urate, which throw back the light so that all rays are directed outward. The oxygen is brought to the cells by the numerous tracheal capillaries that come to the organ and, according to the amount of control of this air supply, we find either a slow glow, as in the larvæ of the lampyrids (called glowworms) and in both larvæ and adults of the cucujos, or we see a quick, sharp, well-timed flash or series of flashes, as in our common fireflies, where the flashes are used by the insects as a distinguishing mark of their species in finding their mate among the mates of several other species all flashing at the same time. In these latter cases the end branches of the tracheal stems that carry the oxygen (air) into the light cells are provided with a radial muscle apparatus that not only controls the flow of air but actually can pump spurts



The fire beetle or cucujo of South America. The beetle is luminous, shining by means of light organs located in the lower corners of the thorax and clearly seen in the case of the specimen reposing on the leaf. A third large light organ on the ventral side of the abdomen is more rarely used, and probably only as a mating signal. (From Mangold.)

[1] See p. 89 of this issue.




The cucujo, shown in the preceding picture, belongs to the family of beetles known as Elateridæ. There is another family of beetles, the Lampyridæ, many of the members of which luminesce. Above is shown a vertical section through the light organ of a firefly, *Photinus*, one of the Lampyridæ. The lettering has the following significance: *tr.*—trachæ; *tr. ep.*—tracheal epithelium, *tr. e.c.*—tracheal end cells; *ref. c.*—reflector cells; *lum. c.*—luminous cells; *ter. t.*—terminal twigs of the trachea. From Dahlgren's and Kepner's *Histology*

of air into the light cells. The illustration shows some of these air-controlling muscle cells, which are called tracheal end cells.

The lower Mollusca come very close to having no luminous members among their vast aggregation of species. Only one bivalve, *Pholas*, and one gastropod, *Phyllirrhöe*, can produce light. The highest and most specialized order of all, however, the cephalopod mollusks, show a very large number of members that are brilliantly illumined by internal combustion or that can spout streams of light into the water. Although these squids can illuminate so beautifully, their cousins, the octopi, show no luminous forms so far as known. Whether the ancient tetrabranch cephalopods could produce light we do not know.

The bivalve (pelecypod), *Pholas dactylus*, may be spoken of as the only luminous clam. It is elongate and bores a burrow-like home in the hard mud in all tropical seas. Its siphon reaches to the surface and in all other ways it feeds and breathes and acts exactly like an ordinary soft clam. If we open it with a knife and examine the interior of its mantle chamber, which is in reality an outer surface of its body, we shall find three pairs of symmetrical, whitish, and swollen glands: one pair, long and cordlike, in the siphon, placed one on each side; another pair, compact and triangular in shape, placed one on each side of the visceral body mass; and a third pair, long and cordlike, placed on the posterior edge of the mantle in such a position that glands adjoin in the median line, thus forming a single, long structure.

In a dark or semidark room these gland masses shine with a vivid green light that drips from them and is easily washed off in sea water or rubbed off on the fingers; more luminous material appears on the surface. A microscopic examination shows that each gland mass consists of thousands of unicellular glands, derived from the surface epithelium but sunk far beneath its general contour. We find two sorts of such glands, one sunk farther than the other, thus forming two layers. One kind secretes luciferin, which appears as round granules of considerable size, while the other secretes a mixture of luciferase and mucus. Since the gland cells open on the surface all together, their contents mix when the integumentary muscles squeeze them out and, meeting oxygen in the sea water, result in a brilliantly luminous mucus. We do not know the purpose for which they are used.

The gastropod, *Phyllirrhöe*, is a very specialized form of this group and unlike most of the other members, which have a heavy shell and live on the sea bottom or on some object on which they can crawl, *Phyllirrhöe* is adapted for a life on the surface of the open sea. Like many plankton animals it is almost wholly transparent. Its body is compressed

into a decidedly fishlike shape with the posterior end enlarged into a fishlike tail. It swims with a fishlike motion, but more clumsily.

In the dark it gives out light whenever stimulated by touch or chemical means. The light comes from the entire surface of the body, and upon microscopic examination one finds many scattered unicellular glands, mostly in pairs or threes or fours, which secrete the necessary luciferin and luciferase. These glands are supplied with large nerve fibers.

The squids are among the most brilliant of our luminous animals. There are so many forms that illuminate that we are forced, for lack of space, to mention but a few typical forms. *Watasenia scintillans* occurs, like most of the light-giving squids, in deep water. It lives in the deep water of the Sea of Japan for most of the year, but during a period of two weeks or more it appears in huge schools near the shore for the purpose of laying its eggs. The masses of squid sparkle and flash in the water in the most brilliant manner, showing a fine, bluish light. An examination of the body of one of them discloses more than four hundred light organs of small size scattered all over the body (mantle), mostly on the ventral surface. These are organs of internal combustion. The principal lights, however, are six in number, three in a row in the tissues of each of the two longest arms. In the dead squid these look like black or bluish lumps seen through the skin. A section of one shows that each is a collection of large cells, from 75 to 100 in number, closely packed together, with the limits of each cell rather hard to see. Through this mass runs an abundant supply of capillaries, some of which appear to penetrate the bodies of the cells themselves. With proper stains we see that the cytoplasm of the cells is filled with very large cylindrical granules of luciferin regularly spaced. The light evidently comes from the oxidation of the outer layers of these large granules. Outside of each organ and covering it as a layer of leaves are large, overlapping, black chromatophores or pigment cells capable of a rapid contraction and expansion at the command of an abundant nerve supply. When the organ is lit up, these chromatophores cause it to flash by their rapid contraction, and cut the light off again by expanding.

Another squid, *Thaumatolampas diadema*, lives in water more than a mile in depth, and has twenty-two light organs, round in shape, on its body. Two of these organs show a ruby-red light, two a sky-blue light, and one an ultramarine-blue light. All the rest are white; an examination seems to indicate that all the lights are in reality white lights and that when they show color, this color is due to a screen formed by a transparent, colored chromatophore, which lies over the white light and gives it its hue.

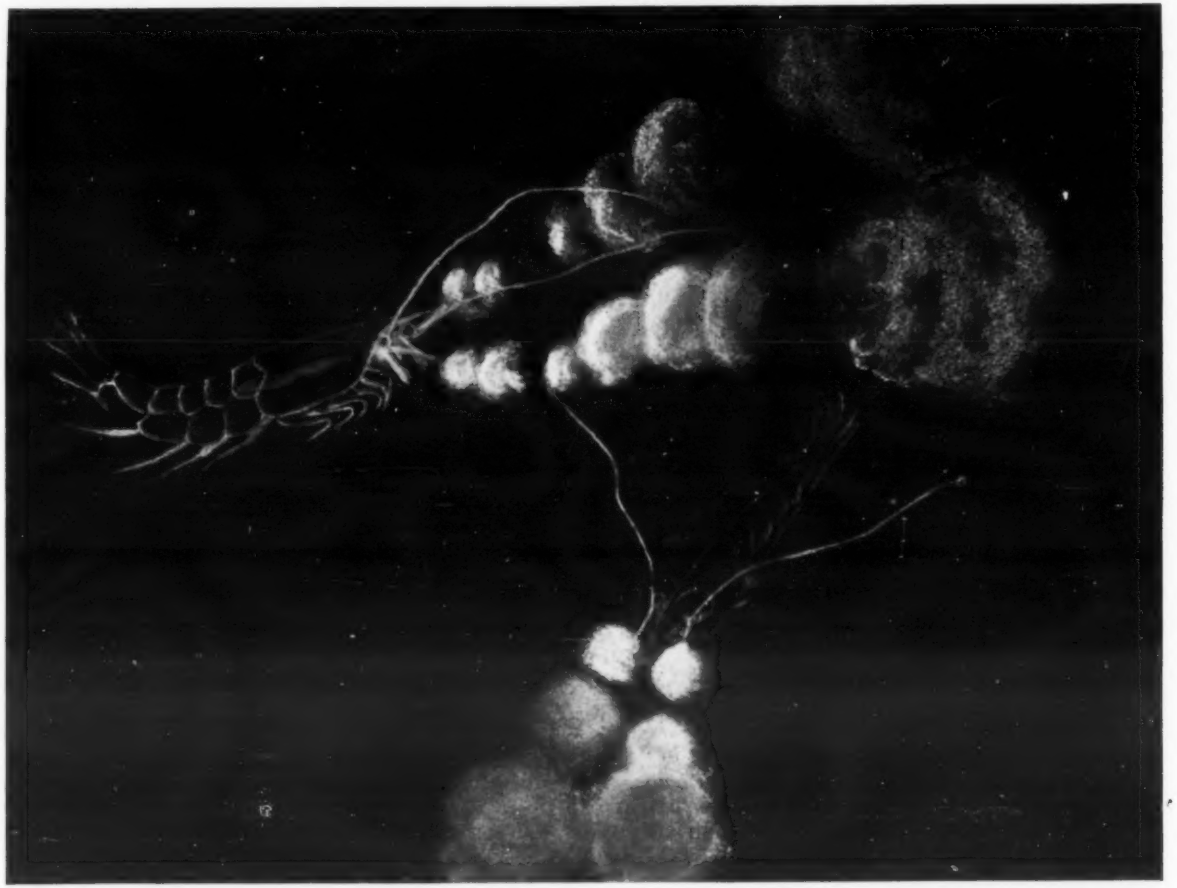
Still another squid lives on the surface of the seas about Italy and other Mediterranean countries and gives out light in an entirely different way. It has two light glands near its ink-sac and the cavity, or reservoir, of each of these glands becomes filled with a mixture of luciferin and luciferase. If struck or irritated by a glass rod, the animal squeezes the glands and the pasty mixture is forced out of several small holes like tooth paste from a tube. The secretion breaks off in little rodlike sections and, becoming caught in the mucus from some neighboring cells, the whole mass is swept out through the siphon, by the respiratory stream of sea water. As the mucus swells and the oxygen-bearing water gets into the mass, a very brilliant light is emitted.

Hundreds, or perhaps thousands, of species of fishes shine in the water by their own light. While the greater number of them live at great depths,[1] a fairly large number are found dwelling among the plankton on the surface, and a few live on the shore bottoms under stones or in the sand. For want of space we can mention only a few examples.

[1]See p. 86 of this issue

LUMINOUS SHRIMPS

They are swimming among seaweed in the proximity of an old stone pier. From a drawing by R. Bruce Horsfall based on descriptions of the writer and originally published in the *Journal of the Franklin Institute*



DEEP-SEA PRAWNS

The heavy, ringlike clouds of light substance emitted by certain deep-sea prawns suggest the smoke rings blown forth by someone idly puffing a cigar. Original drawing by Miss E. Grace White, after descriptions by Alcock and W. W. Welsh. Reprinted from the *Journal of the Franklin Institute*

PELAGIC GASTROPODS

These gastropods (*Phyllirrhöe*), living on the surface of the open sea, have a fishlike shape and are almost wholly transparent. Some of these specimens in the picture show the lighting condition. Drawings by Miss E. Grace White after descriptions by Panceri, Trojan, and the writer

A SCHOOL OF DEEP-SEA SQUIDS

It is in the waters of the Japan Sea that *Watasenia scintillans* is found. The picture shows the different types of luminous organs possessed by this creature. Drawn by Miss E. Grace White after descriptions by Sasaki and others and first published in the *Journal of the Franklin Institute*

Certain small, black sharks living in very deep water have the lower surface studded with thousands of small, even microscopic, lights that give the effect of a bright, steady glow all over this surface. These forms are found in nearly all seas at depths of from 500 to more than 1500 fathoms. The glands are epithelial but of an internal form of combustion. One on its ventral surface. These organs are typical of the light organs of so many other teleost fishes that we are impelled to describe them. The outer surface, composed of the outer epithelial cells of the skin, is lens-shaped and slightly protruding. Beneath this comes the main mass of the light cells which extends downward somewhat below the

Far below the surface of the sea, in depths ranging from 500 to more than 1500 fathoms, where perpetual darkness reigns, live certain small, black sharks that luminesce. Two specimens of such a shark, *Spinax*, are shown in the picture above. The light comes from thousands of minute epithelial organs in the skin of the ventral area. The combined effect of these microscopic lights is that of a bright, even glow over the lower surface of the fish. Drawn by R. Bruce Horsfall after descriptions by Johann, Beer, and the writer

of these sharks, *Spinax niger*, is pictured above.

Another common luminous fish is found in all seas on the surface, sometimes in large schools, at other times singly or scattered in groups. This is *Maurolica*, a genus including several species all much alike. It has a small, herring-like form, usually about three inches long, and shows several close-set rows of light organs, round in shape, inner surface of the general epithelial layer and consists of the inner epithelial cells of this region. These epithelial light cells are large and secrete the luciferin, which (as two or three groups of granules) is contained in little pockets in the cytoplasm touching the surface of the cell. The light is produced by internal combustion, the luciferin being oxidized *in situ*.

Behind this mass of light cells, which

includes the basal layer of the stratified epithelium, comes the reflector, which is a cup-shaped layer of connective tissue, the platelike cells of which are filled with tiny crystals of some organic substance, probably guanin, that collectively have the power of reflecting light. Even after fixation, staining, and mounting in balsam, this reflector continues to throw back the light from a thin section so that it forms a bright, silvery layer on the mounted slide. The reflector is lined on its back surface with a thin layer of black pigment cells, which further prevent the light from passing into the tissues of the body.

Light organs of this essential structure, but of various shapes and sizes, and placed on all parts of the body, though usually on the ventral surface, are found on nearly all the other luminous teleost fishes. It remains to describe a teleost fish, *Photoblephron*, which has evolved a method of external combustion. It is found in the Pacific Ocean around the Island of Banda, where it was studied by Weber and later by Harvey.

Several individuals of the luminous fish, *Photoblephron*, are shown in this picture. The light is continuous and beyond the control of the fish, burning by day as well as by night. However, there is a curtain of black pigment which can be pulled down over the organ, thereby shutting off the light. The luminous organ retains its brightness even when removed from the fish, and anglers of the island of Banda, off the coast of which the fish is found, put this organ on their fishhooks, using it as a night bait. Drawn by R. Bruce Horsfall from descriptions by Weber and Harvey

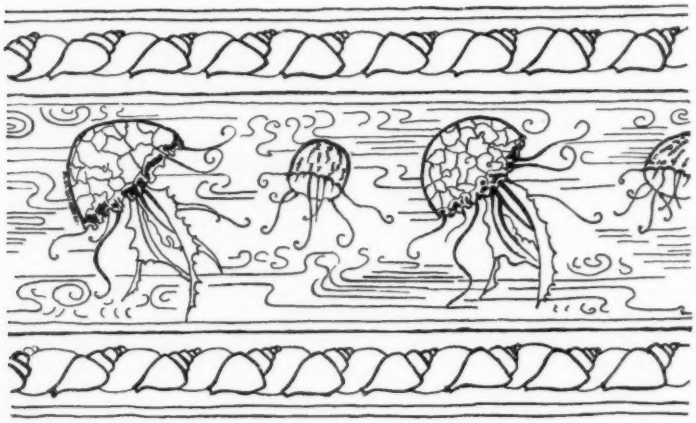
This fish has two light organs, one under each eye. The organ is large and is furnished with a reflector and inner pigment mantle almost exactly like the organ just described. The light cells are composed of epithelial cells of the basal layer, and this is invaginated into a series of tubular glands at right angles to the skin. The luciferin is not secreted

in the cells but is found in bacteria living in the tubules and this mass of bacteria passes outward, being continuously expelled into a series of pockets just under the outer layer of the skin, several glands or tubules emptying into each pocket. These pockets are not closed but each has one or more small openings to the exterior, admitting a small amount of fresh sea water which carries with it the free oxygen necessary to combustion and the production of light. Thus the light is in this instance not subject to nerve control but burns all the time, night as well as day. In order to shut off the light, however, there is a black mantle like a third eyelid, which can be pulled down over the whole organ, the latter turning up and inward to facilitate the operation. In consequence the light can no longer be seen.

This organ is often cut out by the fishermen of Banda, who use it as a night bait for fishing. It is tough and will stay burning brightly on a fishhook for a long time.

Several Lophius-like, pediculate, deep-sea fishes have organs, built on this general plan, on the end of their "fish-rod," or anterior dorsal fin spine, and use these as does the well-known "angler" or "monk-fish" in angling for its prey.

A whole volume could be written in describing other forms of light-producing animals and their light-producing organs. It is hoped, however, that this short account will reveal in small measure what an interesting field for study lies waiting for a solution of its many problems.




Region of the eastern Pyrenees. The writer's automobile tour passed through Carcassonne, Perpignan, Mont Louis, Font-Romeu, the republic of Andorra, and Ax-les-Thermes to Foix and Saint Girons. Ten kilometers north of Saint Girons is the estate of the Comte de Bégouen including the limestone mountain which contains the cavern of Tuc d'Audoubert and Les Trois Frères

# THE BIRTH OF SCULPTURE IN SOUTHERN FRANCE

BY

HENRY FAIRFIELD OSBORN

"Après l'examen souvent trop aride des vestiges purement industriels de nos ancêtres les plus anciens, l'apparition des premières œuvres d'art est à l'archéologie ce qu'est à la vie de l'homme le premier sourire de l'enfance."

"De nos provinces du sud-ouest qui nous apparaissent comme le foyer et le centre de dispersion de cette civilisation, l'art magdalénien se propage au nord et à l'est. A mesure qu'il s'éloigne des rives de la Vézère ou des cavernes pyrénéennes, il perd peu à peu sa fécondité, tout en conservant les traits essentiels de ses caractères et de son originalité."—JOSEPH DÉCHELETTE, *Manuel d'Archéologie*, 1908.

IN SO far as Europe is concerned, it would seem that the art of sculpture had its birth in the imagination of men of the Crô-Magnon race, who, about twenty-five thousand years ago, occupied a large part of western Europe, their art attaining its most intensive development in two regions, namely, the region now known as Pyrénées-Languedoc and the valley of the Vézère in Dordogne. The former region—with the historic centers of Albi in the north, Montpellier and Perpignan along the Gulf of Lyons, the walled city of Carcassonne in the center, the frontier post of Mont Louis and the diminutive republic of Andorra in the south, the mystical grotto of Lourdes on the west and the fashionable baths of Luchon and the glacial cirque of Gavarni—is a veritable encyclopedia of the history as well as of the prehistory of France. The latter region, about one hundred fifty miles to the north, embracing the valley of the Vézère in Dordogne and the adjacent districts, includes the rock shelters of Laussel and Cap Blanc with sculptures of monumental size.

Prehistoric painting, which attained a notable development in both these

regions, also reached a high level in the grotto of Altamira and other caverns of the Cantabrian region in northern Spain, but nowhere else are the treasures of prehistoric sculpture so abundant as in these two regions, where a number of the foremost masterpieces of this Palæolithic art have been discovered. The accompanying list[1] of some of the best known of these treasures will serve to show their geographic distribution, and the grounds for the preceding statement.

| | |
|---|---|
| PYRÉNÉES-LANGUEDOC REGION | |
| Mas d'Azil | Human figurine, horse head (with flesh removed) in reindeer horn, head of horse in act of neighing, swan, mammoth, head of flayed equine |
| Brassempouy | Female figure, woman's head with headdress |
| Lourdes (Les Espelugues) | Horse in ivory |
| Tuc d'Audoubert | Male and female bison modeled in clay |
| VEZÈRE REGION | |
| Laugerie Basse | Human figurine, bovines, reindeer, mammoth head, bison head, and various animals |
| Teyjat | Horse head carved in lignite |
| Les Eyzies | Human statuette |
| Laussel | Four large human figures in bas relief |
| Raymonden (Chancelade) | Horse head in reindeer horn |
| Cap Blanc | Six horses cut in limestone on the cliff wall |
| Comarque | Horse head (bas relief) |
| Gorge d'Enfer | Salmon (bas relief) on the roof of the cave |
| FRANCE, Other parts of | |
| Bruniquel | Reindeer |
| La Trilobite | Beetle |
| BELGIUM | |
| Trou Magrite | Human figurine |
| ITALY | |
| Grimaldi | Female figurine in soapstone |
| SWITZERLAND | |
| Kesslerloch | Various sculptures |
| MORAVIA | |
| Brünn | Human figurine in ivory |

The present article is the outcome of the writer's delightful visit to the Pyrenees and Dordogne regions in 1912 and to the Pyrenees and the collections of Laussel in 1921. In 1912 the author had the good fortune to visit the Comte de Bégouen at his home near Saint Girons twenty-two days after the discovery of the *galerie inférieure* of the cavern known as Tuc d'Audoubert. The accompanying photograph shows the entrance of this cavern—which is on his estate—exactly as it appeared at the time of its discovery. The central figure holding a cane and standing by the edge of the rivulet which issues from the cavern is the Comte de Bégouen; by his side is his eldest son, who has in his left hand one of the acetylene lamps used to light the difficult journey through the cavern; in the background are the two younger sons in a small boat of their own manufacture in which they followed the stream for a distance of two hundred feet when they made the original discovery. The writer returned in August, 1921, to find the Comte de Bégouen more full of energy and enthusiasm than ever, and ready to act as guide to the *galerie supérieure*. In the interval hi-

[1]Compiled chiefly from the *Manuel d'Archéologie* of the lamented Déchelette, and amplified from Burkitt's *Prehistory* and de Morgan's *L'Humanité Préhistorique*.

Entrance to the cavern of Tuc d'Audoubert in the foothills of the Pyrenees near Saint Girons, with the Comte de Bégouen and his three sons as they appeared two days after the discovery of this cavern in 1912

The Salle Cartailhac, named in honor of the late Professor Emile Cartailhac of Toulouse, the finest chamber in the interior of the cavern of Tuc d'Audoubert. Photograph by permission of the Comte de Bégouen

Salle des Bisons. The bull (left) and the cow (right) bison sculptured from the red clay found on the floor of the adjoining Salle de Danse in the cavern of Tuc d'Audoubert. Photograph by permission of M. Jean Brunhes

three sons had safely emerged from the hazards of the war with decorations for gallantry.

In the early summer of 1914, before the beginning of the fatal World War, these three lads had observed a very small opening in one of the side walls of the *galerie inférieure* through which they were barely able to squeeze their slender bodies. Undaunted by difficulties, they pushed onward along what is now known as the *galerie supérieure* into the superb chamber of stalactites, subsequently designated the Salle Cartailhac—in honor of Professor Emile Cartailhac, the veteran archæologist of Toulouse, whose death after a long and honorable career as the dean of French archæology has recently been announced.[1] From the Salle Cartailhac openings lead in several directions—in fact, on the occasion of the writer's recent visit the party nearly lost its way in this part of the cavern on the return trip. The labyrinthine nature of the cavern and the extreme narrowness of the passages failed to deter "*les trois frères.*" They courageously pushed their way onward and upward, wriggling like serpents through narrow spaces, until after a final, most difficult passage, the narrowest of all, they entered a chamber 50 feet long and 30 feet across with a ceiling about 12 feet high. On the floor at the end of this chamber they found traces of a small circle built of stones, and could hardly believe their eyes when their lanterns flashed upon a pair of bison modeled in clay, consisting of a cow in front and a bull following, both leaning with the left side against a large mass of clay. One of the most astounding discoveries in the whole history of French archæology was thus made through the courage and enterprise of these three lads—namely, that the sculptors of Palæolithic times were familiar with the use of modeling clay and employed this as a medium of expression and perhaps even for prelimin-

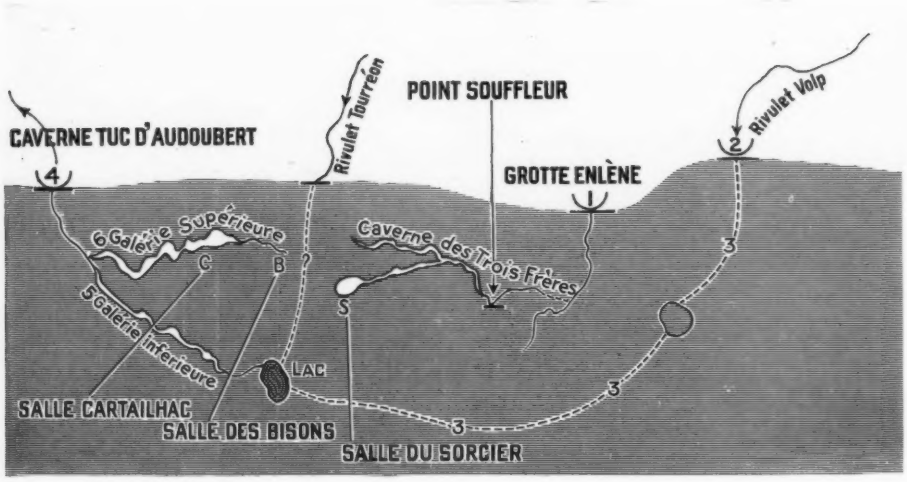
[1]See p. 92 of this issue

ary study of works subsequently to be executed in the more enduring medium of stone, exactly as our sculptors do today. They were also extremely skilful in the use of this clay and the photographs taken with the acetylene light convey little idea of the extraordinary accuracy of the great lines of musculature indicated in the fore quarters, neck, and head.

The lads did not tarry to make such detailed observations as these, but hastened back to announce their discovery to their father; and to our mind the courage which the sons displayed was less remarkable than that of their father, who immediately returned to make the same, most difficult ascent. How the Count ever succeeded in forcing his stalwart figure through the narrow passages—impossible to any but the most accomplished 'cavernist'—we cannot imagine. At the time of our visit in 1921 iron ladders, steps, and other aids to the ascent had been prepared, and inconvenient masses of limestone had been chiseled down; but notwithstanding such provisions the ascent was the most difficult and arduous of its kind that we have ever undertaken. At one point it was necessary literally to crawl upon one's face—'*ventre à terre*'—and when halfway through to turn on one's side because the two pillars of limestone are too close to allow the shoulders and hips to pass. Our admiration of the Comte de Bégouen increased every moment. When finally we emerged into the Salle des Bisons, we were completely out of breath but spiritually prepared for the greatest impression of our life, namely, the sight of an atelier preserved exactly as it was left by the prehistoric sculptors twenty-five thousand or more years ago, with the bison still soft to the touch and the mass of clay as yet only slightly contracted by dessication, exhibiting two vertical cracks in the figures, which are clearly shown in the accompanying photograph by M. Jean Brunhes. The mass of clay against which these bison lean is also clearly shown. The tail of the right-hand (female) bison has dropped to the ground. On the other side of the mass of clay is a third, uncompleted figure of a bison, and a model of a fourth partly finished. Near by are several rolls of fresh clay, indicating that this material was carefully worked before being applied to the model. It is impossible to convey any idea of the impression made upon our mind by the Salle des Bisons and especially by the two central figures which give it its name. As the light from the lantern is slowly passed round these scu'ptures, one realizes that they are triumphs of impressionism. The effect is one of suggestion conveyed by strong, sure strokes of the modeling tool. There is absolute truth of proportion, and to this all matters of detail and retouch are subordinate.

Not far distant is a small, depressed chamber where one can observe fresh prints of hands and feet—the footprints being of very delicate type, deeply impressed into the fresh clay, and subsequently covered with a very thin coating of limestone. This recess is called the Salle de Danse although there is no evidence of any such ceremonial having

Heel-cast from the Salle de Danse adjoining the Salle des Bisons in the cavern of Tuc d'Audoubert. Presented to the American Museum of Natural History by the Comte de Bégouen. One third actual size

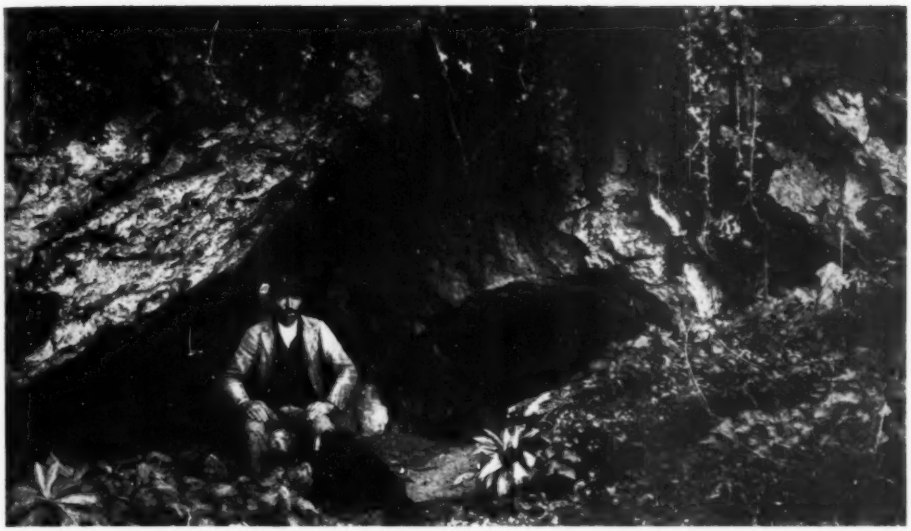



Plan of the interior of the limestone mountain of Tuc d'Audoubert on the estate of the Comte de Bégouen, showing the location of the caverns and their entrances and the supposed course of the subterranean streams; redrawn from a sketch by the Count

taken place here. The heel prints are limited in number and may well have been made while the sculptors were gathering clay for the bison models. In fact, there is no evidence that this chamber was devoted to any purpose other than the execution of these bison sculptures and it may never have been visited again. This is the ever recurring mystery of Palæolithic purpose. The subject of the two bison, male and female, relates to the reproductive instinct and not directly to the chase as in the case of the bison drawn in the not far distant cavern of Niaux with arrows indicated on their sides. As we return from the Salle des Bisons and descend along the *galerie supérieure* there are evidences of occupation, not only by the cave bear but by cave man, who has left little heaps of scattered implements and bones showing that several parts of the cave had been inhabited for short periods during the winter season—perhaps when the constant internal temperature of $12\frac{1}{2}$°C. ($54\frac{1}{2}$°F.) rendered the interior far more habitable than the country without, subject as that was to the severe climate of the Pyrenees in the Ice Age.

### DISCOVERY OF THE CAVERNE DES TROIS FRÈRES

At the top of the same little limestone mountain containing the cavern of Tuc d'Audoubert is an opening long known to the shepherds of the region as the 'Point Souffleur' from which the relatively warm air currents of the cavern issue in winter and melt the snow, while relatively cool breezes issue in summer. On July 20, 1914, the Bégouen brothers suddenly decided to descend this rock chimney and see where it led. They were let down by a long rope and upon reaching the bottom found themselves in an entirely new cavern, which has since received the name of Les Trois Frères in honor of its discoverers. Even the preliminary survey made by these youths revealed that —though not far distant from the cavern of the Tuc d'Audoubert—it represented an entirely different art period and a cavern technique of another order; that its walls were fairly covered with designs; and that the relatively few flint-incised outlines were executed in an entirely different style. Every available surface of the Trois Frères, whether ceiling or



Entrance to the grotto of Enlène on the side of the mountain of Tuc d'Audoubert, discovered many years ago, where Magdalenian industrial deposits were found from which was obtained the well-known Enlène *propulseur* (dart-thrower), carved in reindeer horn

Entrance of the stream Volp in the side of the limestone mountain of Tuc d'Audoubert, which —traversing the mountain—may be identical with that which issues from the entrance of the cavern of Tuc d'Audoubert shown on p. 32. Photograph by permission of the Comte de Bégouen

Etched figure of reindeer (upper) and of Celtic horse (lower) in the cavern of Les Trois Frères. From photographs reproduced by permission of the Comte de Bégouen

sides, has a design upon it, and it has required two seasons of very hard work on the part of the eminent historian of prehistoric art in France, the Abbé Henri Breuil, to reproduce these etchings. We had the pleasure of meeting the Abbé Breuil at the Château des Espas, the residence of the Comte de Bégouen, and learned from him that there was still several months' work to be done. The walls which the prehistoric artists faced were uniformly covered with a brown coating quite unlike that of the limestone of other caves. They solved the difficulty by scratching off this coating to produce a strong, *white* contour line instead of the black which outlines the animals pictured in the Niaux cavern, or the deep, flint-incised outlines seen in the adjacent cavern of Tuc d'Audoubert.

This is well shown in the reindeer and the small Celtic horse reproduced herewith. The photographs do not reproduce with sufficient clearness the effect of these etchings, so the whites and blacks have been slightly intensified to convey to the eye the effect actually given when such etchings are surveyed with a powerful acetylene light. So perfectly portrayed are the exact proportions and characteristics of these two animals, that, even if they be critically examined by a zoölogist, there is no mistaking either the genus or the species to which they belong. The distinguishing points in the Celtic horse are the small head and the high, arched neck and white mane of the stallion. In the reindeer the broad contour lines beneath the head and the body, which are part of the scheme of protective coloration or concealment, are indicated by removing the brown surface from a considerable area, leaving only a patch of brown here and there to indicate the limbs and shading. In the case of the pony the white coloring extends beneath the jaw and the belly line. Thus not only the contour but also the coloring of these two animals is very clearly and characteristically indicated. The entire silhouette of the upper part of the body is absolutely accurate and true to life.

This unique style and greater freedom in drawing distinguish the work found in the Caverne des Trois Frères, which presents all the characteristic mammalian life of the period, namely, the horse (of different species) and the reindeer (a single species)—both favorite subjects—the mammoth (less frequently portrayed), the bear, the lion, the panther, the stag, and—most numerous because most coveted for food—the bison. All these animals and others more recently discovered—which, for the present, we are not at liberty to mention—are portrayed with the same fidelity by these Palæolithic artists. Thus we have a complete portrayal of the mammalian life of the Pyrenees in this early period of Magdalenian art, probably antecedent to the period of mural painting.

In speaking above of the discovery of the Caverne des Trois Frères we did not recite the fact that for a second time the Comte de Bégouen hurried to the spot, ran all the risks, and verified this fresh discovery by his three sons. The cavern is still very difficult of access—"*très pénible*" in the words of the Count. It is necessary to crawl, to stoop, to pass certain points on one's back or sideways, yet it has been visited frequently by the Count and by the late dean of French archæologists, Emile Cartailhac. We were also conducted by Mlles. Denise and Lisette de Lalanne, the daughters of Dr. Gaston de Lalanne, of Bordeaux, a well-known French archæologist and eminent also as a physician. Both of them had donned brown miner's suits for the occasion.

Again the *élan* of the 'cavernist' carried us through all difficulties into the final chamber, where on the ceiling we perceived in faint relief the painted figure of the Sorcerer. We were at last in the Salle du Sorcier, where, surrounded by numerous etchings, this strange medicine man presides. To the

painstaking and minute observation of the Abbé Breuil we are indebted for the elucidation of all the details presented in the accompanying drawing. The interest of this figure of the *Sorcier* is enhanced by the fact that it is not a unique representation. Though far more perfect and of larger size, it strikingly resembles the engraving of a sorcerer found many years ago in the now miraculous grotto of Lourdes. Each figure is terminated with a fox's tail and is surmounted with the horns of a stag, and from each face hangs the long, pointed beard. The Trois Frères figure is superior in showing the mask and ears of a fox and the apparent insertion of the arms of the sorcerer in the pelage of the forearm of a bear or some other carnivore—that is, the hands are masked like the face, while the feet, the trunk, and the thighs are either covered with fur or, more probably, painted in stripes. The remainder of the body is etched on the brown-coated rock very much in the same manner as the animals are etched in other parts of this wonderful cavern. The figure is represented partly stooping in a gesture which the Count well describes as "*le geste de faire le beau*," an attitude which is also observed in some of the drawn figures in the grotto of Combarelles. Following his description of this strange figure, the Comte de Bégouen writes:

Ce mélange de caractéristiques nous fait écarter également l'idée d'une mascarade rituelle spéciale. Catlin, à qui il faut toujours revenir, nous décrit des danses de l'ours ou du bison dans lesquelles le ou les participants revêtent les têtes de l'animal qu'il convient d'honorer et de rendre favorable ou au contraire de détruire. Si donc l'imagination s'est donné libre carrière dans la confection en quelque sorte synthétique de l'accoutrement, c'est qu'il s'agit de représenter soit un esprit supérieur ayant par conséquent les attributs des différents animaux qu'il domine, soit l'homme capable par son pouvoir magique d'en être également maître. Nous avons des quantités d'exemples de l'un et de l'autre cas chez tous les peuples primitifs, des Esquimaux aux Australiens en passant par les indigènes de l'Afrique ou de l'Amérique, les Sounis en particulier.

Dans le premier cas, il s'agirait de la repré-

Painting and engraving of the Sorcerer as it appears on the roof of the Salle du Sorcier in the cavern of Les Trois Frères when illuminated by a strong acetylene light. Photograph by permission of the Comte de Bégouen

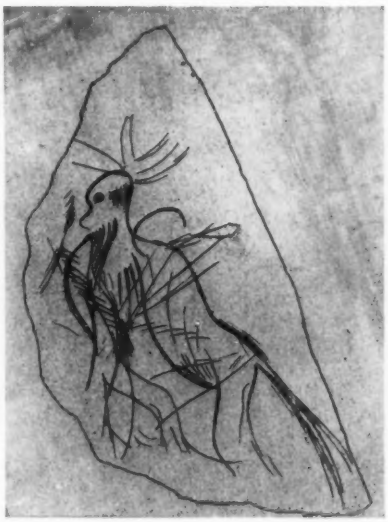
sentation d'une sorte de divinité, dans le second, de celle d'un sorcier. C'est vers la seconde hypothèse que nous penchons. Nous croyons que l'artiste quaternaire a voulu représenter un magicien. Dans quel but, nous l'ignorons. Rien ne nous permet de deviner la mentalité qui était la sienne ni la préoccupation à laquelle il a obéi.

Il semble que cet artiste, c'était le sorcier lui-même, qui aurait tracé avec minutie et fidélité son propre portrait revêtu de ses attributs rituels. Il l'a placé dans le recoin le plus reculé de la caverne inférieure, mais sur une paroi dominant ces centaines de figurations d'animaux que lui ou ses confrères ont, pendant de longues suites de générations, tracées pour des envoûtements. Car tout dans cette caverne nous parle de magie.

doubt that this entire mural art is connected with the spirit of the chase.

### THE SCULPTURES OF LAUSSEL

In the more northern art center around the valley of the Vézère is the grotto of Laussel, where Dr. Gaston de Lalanne has been working for many years and has been rewarded by the discovery of the most remarkable series of prehistoric sculptures of the human figure which



(Left) Engraving of a sorcerer found on a piece of schist rock in the grotto of Lourdes, now preserved in the Musée de Saint Germain, reduced to about half the actual size

(Right) Engraving and painting of the Sorcerer on the roof of the Salle du Sorcier in the cavern of Les Trois Frères, as interpreted by the Abbé Henri Breuil, one-fifteenth actual size

None of these drawings are removable. The figure of the sorcerer itself is not very conspicuous and to make out all its characteristics has required the most microscopic study on the part of the Abbé Breuil. It was necessary to visit this cavern personally in company with one of the archæologic experts of France, to appreciate the full meaning of this art and to discover the inconspicuous but most significant pictures. There is little

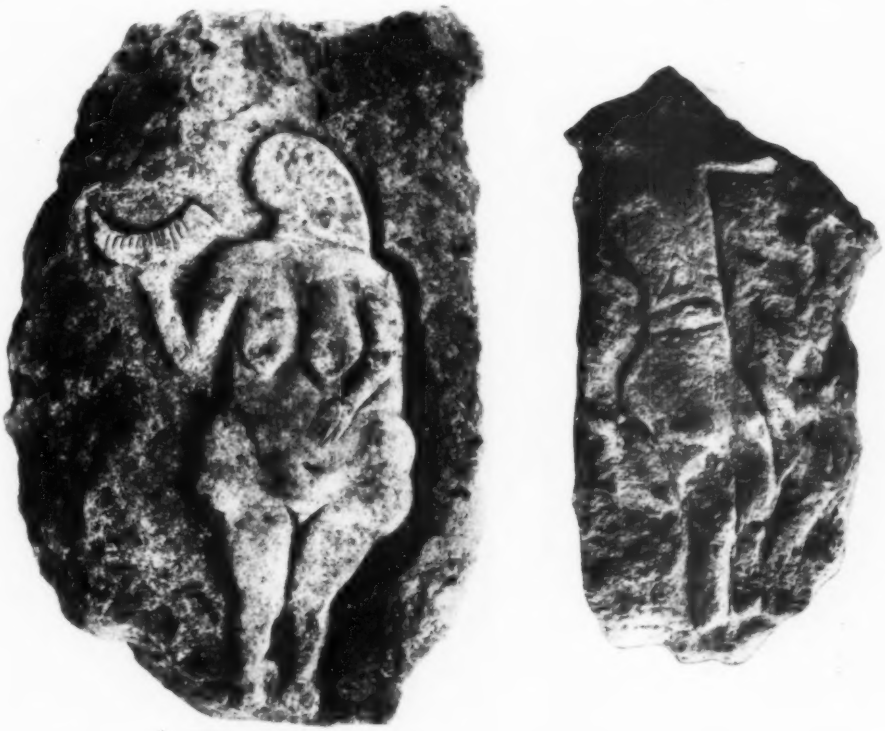
have been found in France. The site is shown in the photograph on the page following. The figure which Dr. Lalanne in his capacity of student of prehistoric remains calls "*la bonne femme de Laussel*" was found at the point indicated by a white cross on the projecting point of rock beneath the shadow of this grotto, which Dr. Lalanne regards as possibly an ancient sanctuary. *La bonne femme* has the robust proportions of all the feminine statues of the period and, like the others, is the work of a race which held that

The rock shelter of Laussel, supposed to be an ancient sanctuary, which contained four Palæolithic bas-reliefs in stone, including those known as "*le chasseur*" and "*la bonne femme de Laussel.*" The latter was on the stone indicated by a white cross. Reproduced by permission of Dr. Gaston de Lalanne

maternity is the chief end of womanhood. There is no effort at the expression of either beauty or proportion of figure, and the rough, brown sandstone does not admit of anything in the nature of delicate sculpture of the face and head —a part of the human body far too difficult for the sculptors in this remote Aurignacian period of the development of their art. A second figure of a woman is inferior in design to *la bonne femme.* A third feminine figure is more or less symbolic of the act of parturition.

None of the feminine figures betrays any attempt on the part of the artist at the expression of the beauty of the human form, and we might infer that the Crô-Magnon artists of this time—so keen to portray the beauty of the animal form—were indifferent to it in mankind,

were it not for the companion statue of *le chasseur*, which Dr. Lalanne found within a few feet of *la bonne femme*. We had the privilege of examining all these statues in a powerful light in Dr. Lalanne's studio in Bordeaux, and were deeply impressed, not only by the real beauty of the masculine figure of the hunter, but by the evidence it gave of surprisingly close observation of anatomical detail. The pose is extremely fine and the figure may be conceived as in the act of either throwing a spear or drawing a bow. The broad shoulders and slender, girdled waist remind us strongly of figures of Apache hunters, and also of the cup-bearers from the palace of Cnossus, Crete. The body faces slightly toward the front, and one may perceive the line where the thorax joins the abdomen—that is, the lower line of the ribs, above the slender abdominal line of the typical hunter. More remarkable, at the top of the shoulder one can perceive the swelling of the deltoid muscle and the point where it subsides into the brachialis as in the modern athlete. The head is turned to the left, indicating that the face was looking in the direction of the spear or of the arrow, but there are no indications of the features—in fact, it would have been impossible



(Left) *La bonne femme de Laussel*, bas-relief of a woman with a drinking horn, found within the rock shelter of Laussel and described by Dr. Gaston de Lalanne in 1912, belonging to the late Aurignacian age. One sixth actual size

(Right) *Le chasseur de Laussel*, bas-relief of a spear-thrower or archer, sculptured on the face of a boulder found within the shelter of Laussel and described by Dr. Gaston de Lalanne in 1912, also of late Aurignacian age. About one sixth actual size

in this coarse sandstone and with the tools then available to model the human features.

Dr. Lalanne has a superb collection of Aurignacian flints, including hammer stones and chisel-like implements with which the sculptor may have worked. His atelier is crowded with a series of implements which give us all phases of the grand Aurignacian flint industry. Near the *bonne femme* was found an assemblage of the finest types of flints —possibly an accidental association, though Dr. Lalanne considers that the sculptors probably employed a variety of implements in roughing out and preparing the ambitious statuary of his priceless collection. Of the same age are a number of very large implements— hammer stones, planing stones, and *pics* —which were well adapted to this massive work and to such undertakings as the subsequent Magdalenian horse sculpture of Cap Blanc. To the prehistoric archæologist the age of these statues is the matter of commanding interest. It is determined by the excavations of Dr. Lalanne as *Aurignacien supérieur* beyond the possibility of doubt.

We may point to the industrial parallels which he finds between the grotto of Laussel and other famous and typical sites as indicated in the table below.

We are not inclined to accept the theory of Dr. Lalanne that the Laussel sculptures represent the negro-like Grimaldi Race, which, our readers will recall, is the only Palæolithic race with the negroid type of face thus far discovered, and is represented by two skeletons found in the Grottes de Grimaldi on the Mediterranean near Mentone. Thus far no evidence of the practice of burial has been found in any of these excavations at Laussel. It is true that in the search for burial places Dr. Lalanne came upon the famous series of sculptured horses at Cap Blanc, which are regarded as belonging to the art of early Magdalenian times, and therefore as somewhat more recent than the human sculptures of

| | | |
|---|---|---|
| Font Robert | AURIGNACIEN SUPÉRIEUR of Laussel. Here we find the five large sculptured figures—*la bonne femme* and *le chasseur* among them—as well as narrow, flint spear-heads worked on both sides with a shallow notch at the base of either edge for attachment to a shaft. | CRÔ-MAGNON RACE |
| Crô-Magnon Grotto. Containing the type of the Crô-Magnon Race | AURIGNACIEN MOYEN A superb flake industry, with beautiful *racloirs* and *bifaces*. | CRÔ-MAGNON RACE |
| Gorge d'Enfer | | CRÔ-MAGNON RACE |
| Aurignac Grotto | | CRÔ-MAGNON RACE |
| L'Abri Audi. *Lissoirs* and *pointes de Châtelperron* | AURIGNACIEN INFÉRIEUR Typical Aurignacian industry. | CRÔ-MAGNON RACE |
| La Quina. Latest period of the Neanderthal Race | MOUSTÉRIEN SUPÉRIEUR (Last of Neanderthal Race.) Close of the Mousterian industry | NEANDERTHAL RACE |
| Chez-Pourré near Brive | MOUSTÉRIEN MOYEN Typical Mousterian industry (a period of long duration) | NEANDERTHAL RACE |
| Combe Capelle. The industry includes a few *coups de poing* | MOUSTÉRIEN INFÉRIEUR Numerous *bifaces* and remains of reindeer. | NEANDERTHAL RACE |
| La Micoque | ACHEULÉEN SUPÉRIEUR *Bifaces* predominant. No trace of reindeer. | NEANDERTHAL RACE |

Laussel. Our principal ground for dissenting from the theory that the Grimaldi Race was portrayed in the Laussel sculptures is that repeatedly expressed in *Men of the Old Stone Age*, namely, that all this art, both mural and sculptural, is the work of a single racial mind and racial spirit. New types of implements may have come in by invasion, but in the orderly development of a single art—an art marked by the combined love of beauty and truth—we have the most positive proofs of the craftsmanship of a single race.

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Life-size horse at Cap Blanc, sculptured in high relief, of early Magdalenian age, now one of the national monuments of France. After Lalanne in *l'Anthropologie*, 1911

# SOME FEATURES OF MUSEUM PROGRESS DURING THE PAST FIFTY YEARS

BY

FREDERIC A. LUCAS*

THE past half century has witnessed great progress in museums, not only in the growth of their collections, the increase of their scientific work, and the publication of results achieved; but in methods of preparation, in the manner of installing exhibits, and in the utilization of these exhibits with their accompanying labels, together with lectures and handbooks, for the purpose of illustrating ideas and placing information before the public: and in all of these phases of improvement the American Museum of Natural History has played a leading rôle.

No one individual can claim the credit for this progress, nor is it due to any one favorable circumstance; many men and many events have helped, but the great factor has been not merely the ability but the readiness to take advantage of opportunities, for when opportunity knocks at the door, the householder must be ready to open, otherwise the visitor may go elsewhere.

It is this willingness or eagerness to grasp new ideas, to take advantage of inventions and improvements in methods, that distinguishes the progressive from the unprogressive museum or, for that matter, any enterprising institution from its laggard fellow.

It may be said—and truthfully—that the American Museum of Natural History owes much to the generous support it has received from its trustees, but this support would not have been given had it not been thought warranted by the Museum's progress, especially as evidenced by the educational work accomplished through its many and varied activities.

Fifty years ago, when the American Museum of Natural History came into being, the aim of a museum—so far as its exhibits were concerned—was to show the public a series of named objects upon which visitors were permitted to gaze, but not encouraged to do so, the privilege being frequently restricted to certain hours on stated days. To illustrate ideas or to show the use of these objects—or their habits if they chanced to be animals—was, we will not say not thought of, but certainly not done, and it was not even deemed necessary to show them to the best advantage.

There were then but three museums of prominence in the country, and all of these were in the earlier stages of their existence. The United States National Museum was housed in the Smithsonian Building; the Museum of Comparative Zoölogy was small and struggling, and the Philadelphia Academy of Sciences was not large. None of them looked upon exhibition as a prime function, and such institutions as the Peabody Museum at Salem and that of the Buffalo Society of Natural Science were conducted on much the same lines. A museum was not an institution by itself so much as an adjunct to some scientific society.

The change in the attitude of museums toward the public is due not merely to change in ideas, but in the ability to carry ideas into effect, and this ability is in turn largely due to improvement in methods and materials by the use of which it has been possible to arouse the interest of the public; if you cannot interest visitors, you cannot instruct them. The success or failure of a museum depends, in popular parlance, upon its ability to "put over" the message it wishes to convey.

Now the educational work of a museum is more dependent on its mechanical work than one might suppose, and progress in the one reflects, or is largely

*Director of the American Museum

due to, improvements in methods of the other. Heads and hands are sometimes more interdependent than the heads are willing to admit. Thus our knowledge of the life of the past, of the structure and habits of such creatures as dinosaurs, with no near living relatives, is directly due to improved methods of collecting, preparing, and mounting. It makes a great difference, particularly with large animals, whether they are studied in whole or in parts and many features are not realized until the entire skeleton is seen. The American Museum of Natural History may justly claim to have brought these branches of museum work to a high stage of perfection.

Many improvements in methods have a place in the history of the various departments of the Museum with the progress of which they are intimately related, notably so in the case of the departments of birds and of fossil vertebrates, and one phase has been dwelt on at some length in the *Guide Leaflet* "The Story of Museum Groups."[1] As there recorded, the group of today is the result of a combination of improvements in many branches of work but, more than this, it is the result of inventions and improvement in lines in which the Museum is not directly concerned, but of which it has taken advantage, and without which results such as are now obtained would not be possible. For example, so long as the only foliage available was composed of the crude, cloth leaves made by dealers in millinery supplies, it was not possible to copy nature with any degree of realism. Then came the Mintorns with their method, later superseded by that of Akeley, and "habitat groups" began to spring up in the land.[2]

[1] "The Story of Museum Groups." *Guide Leaflet Series*, No. 53. By Frederic A. Lucas.

[2] It is quite possible that the modern preparator with his varied materials ready at hand and mechanical devices ever at his command does not appreciate the difficulties under which his predecessors labored, nor give them due credit for what they accomplished. What would the modern man do without gas and electricity and his steam-heated workrooms? What would he think if he could not get such simple materials as cotton batting and wire cloth, if he had to grind his own colors, refine his own beeswax and use hand-wrought nails? Would he not throw up his hands in despair?

Probably no one invention has been of more importance to museums than that of electric lighting, for without it our beautiful habitat groups would have been practically impossible. The difficulty of employing gas with its heat and fumes, the impossibility of using so inconstant and uncertain a light as daylight would have limited the exhibiting of habitat groups to certain times of the day and even of the year. But this is only one incident, so to speak, for before electric lighting became universal, museums were poorly lighted, if lighted at all, and there are those who think the day is not far distant when, so far as exhibition is considered, daylight will be discarded and halls illumined by electric light only.

It is not claimed that the American Museum has led in *everything*, that it has invented all the methods and devices now in general use, but many of them have originated within its walls and it has been ever ready to avail itself of others.

In the matter of animal groups, the American Museum of Natural History was anticipated by the United States National Museum and the British Museum, but in the shape of habitat groups,[1] the American Museum carried them to a much higher degree of perfection, and if some of the largest and finest groups of mammals are now to be found in other institutions, it is to be remembered that these museums have profited by the costly experiences and experiments of the American Museum of Natural History, and that they were planned and executed by preparators who had gained their knowledge in this institution. And

[1] As "habitat group" has come to have a rather definite meaning in museum circles, it may be well to give here a definition taken from Doctor Chapman's introductory remarks in the *Leaflet*, "The Habitat Groups of North American Birds." "These groups of birds are designed to illustrate not only the habits but also the haunts or 'habitats' of the species shown. Each group usually includes the nest, eggs and young, besides the adult bird or birds, with a reproduction of from 60 to 160 square feet of the nest's immediate surroundings. To this accurate and realistic representation of the home of the species is added a painting from nature of its habitat, the real foreground being connected with the painted background in such a manner that one often does not at first see where the former ends and the latter begins. The whole, therefore, gives an adequate conception of the nature of the country the birds inhabit and the conditions under which they live."

if the genius of Akeley devised the methods that did more than anything else to make taxidermy an art while he was at the Field Museum, yet his last and one of his most important processes was thought out and put into practice at the American Museum of Natural History.

Glass models of invertebrates were made by the Blaschkas—father and son—in the seventies, but although the use of glass in the American Museum of Natural History was begun only in 1907, yet in the skilful hands of Mr. Herman Mueller, under the direction of Mr. Roy W. Miner, have been wrought during the past decade marvels of glass that make the work of the Blaschkas seem crude. Here is one of the instances where mechanical skill far outweighs scientific knowledge: a student may thoroughly understand the structure of a radiolarian, may be able to make an accurate drawing of it, but to transmute the drawing into fragile glass and make it understandable to everyone is quite another matter.

The American Museum of Natural History cannot claim the credit of having introduced what may be called the explanatory label, for this, we think, was done—or first done—on an extensive scale by Doctor Goode at the United States National Museum, but the American Museum was not long in adopting what I believe to be still the most effective mode of imparting information to the public at large.

Much time and thought have been given to the problem of devising labels that shall be not only instructive but shall so present the information contained that it will be interesting. With the aid of a dictionary or a textbook, almost anyone can write a technical label. It matters not how much information is contained in a label if it be not read; getting it read is the great problem and here much depends on the manner in which the accompanying object is shown.

In the matter of publications couched in untechnical language, which in a way are extended or amplified labels, the American Museum of Natural History has improved its opportunities. The credit of introducing guide leaflets belongs, however, abroad, for they were issued by the British Museum, and what is probably the best series of handbooks or leaflets, as regards the interesting manner in which the subjects are presented, is that issued by the Horniman Museum. This is said without any reflection on any institution—it is not given to every writer to set forth his subject in an interesting way, any more than every student can hope to be a Huxley or a Darwin.

The *Leaflets* of the American Museum were an offshoot of the AMERICAN MUSEUM JOURNAL, commenced in 1901 as a means of keeping members informed of the work of the Museum: the first was a "supplement," reprints being issued as *Guide Leaflet* No. 1.

In 1907, the *Leaflets* were issued independently of the JOURNAL and in 1912 the series of *Handbooks* was begun, dealing with subjects illustrated by the collections rather than with the objects themselves.

Fifty years ago illustrated lectures were just beginning to be common, "magic lanterns" for "dissolving views" were installed in but few institutions, and colored lantern slides were something to be wondered at. Today every school and even many classrooms have a projection apparatus; the audience almost feels insulted if shown a plain photograph and expects a reel or two of motion pictures.

Professor Bickmore and the American Museum of Natural History were pioneers in this line of museum work; the colored lantern slides of flowers prepared for him have never been excelled, and the state has borrowed from the museum the idea of illustrated lectures for the schools.

Thus we have progressed from the regular rows of animals most literally

stuffed to the habitat group portraying amid their natural surroundings animals, each of which is as carefully and accurately modeled as a statue or, if small, cunningly wrought from glass or wax that exactly reproduces nature; from the label bearing only a name and a locality to the explanatory label and through this to the leaflet and the handbook; from an occasional lecture to series of carefully planned lectures in which nature is shown in her true colors and her subjects portrayed in action, and delivered not only in the Museum but in distant lecture centers.

It is not what a museum *has* that counts, but what it *does;* the servant who buried his talent in a napkin brought no return to his master; the museum that keeps its treasures to itself makes no return to the public or to science. The American Museum of Natural History has ever lived up to its motto, "For the people, for education, for science," keeping the people and their education uppermost, yet, in doing this, not being unmindful of the demands of science. It has always given freely to other institutions its ideas, its information, and its methods, so that progress has not been confined to itself but has been general. Whereas fifty years ago museums could be counted on one's fingers and were looked upon as being for the benefit of a favored few, today they are spread throughout the length and breadth of the land, are recognized as being for the people, and are regarded as among the most efficient instruments of both popular and advanced education.

THE STRUGGLE FOR EXISTENCE AT THE MARGIN OF A TIDE POOL

The crevices of the rock overhanging the pool and forming its sides are crowded with black mussels (*Mytilus edulis*) of small size. These are being invaded by hosts of gaily colored "purple" sea snails (*Thais lapillus*) which bore minute holes in the shells of the mussels and devour them

# BIOLOGICAL WORK ON MOUNT DESERT ISLAND

BY

ROY WALDO MINER*

"STUDY Nature, not books," the motto of the great Louis Agassiz, shows prominently above the lecture platform in the Marine Biological Laboratory at Woods Hole, Massachusetts. This is the aim of the chain of seaside laboratories which have gradually been established along the coast during the last half century for the study of marine life in its natural environment. The importance of the work of these institutions cannot be overestimated. Through them, biologists from most of the colleges and universities of the United States and Canada turn annually to the sea, the original abode of animal life, and penetrate its watery veil in search of the secrets of the abundant life hidden beneath, secrets the knowledge of which is fundamental to the study of living organisms, including man himself. The Marine Biological Stations of the United States and Canada now include those at Woods Hole, Massachusetts; Cold Spring Harbor, Long Island; Mount Desert, Maine; St. Andrews, New Brunswick; Beaufort, North Carolina; Miami and Tortugas, Florida; La Jolla and Pacific Grove, California; and Friday Harbor in Puget Sound,—thus affording an opportunity for the study of marine life in a great variety of environment.

Some of these, like the Marine Biological Laboratory at Woods Hole, are large institutions, with hundreds of students and investigators utilizing their facilities annually. Others counteract their smaller size by the earnestness and intensity with which they pursue their work. Noteworthy among these is the Harpswell Laboratory, which has recently established its Weir Mitchell Station at Salisbury Cove on the sheltered northern shore of Mount Desert Island, Maine, about six miles from Bar Harbor. Founded in 1898 by Prof. J. S. Kingsley, then head of the biological department at Tufts College, the laboratory made its headquarters for nearly a quarter of a century at South Harpswell, on Casco Bay, where it attained an enviable record for research work, especially on marine life.

As stated in its prospectus for 1921, it became in the past year a member of The Wild Gardens of Acadia Corporation, of Mount Desert Island, where a tract of fifteen acres was offered it for the establishment of a new station. Here the conditions for the work and future development of the laboratory are so favorable that a period of rapid progress and greatly increased scientific usefulness is assured, under the able management of its director, Prof. Ulric Dahlgren, of Princeton University. The first season in the new quarters has been very successful, and the prospects for the second summer's work are correspondingly good.

Salisbury Cove is a picturesque little fishing and agricultural village, a relic of a bygone time. Years ago it was famous as a ship-building community, and in the days of sailing vessels many a fine ship could be seen in foreign ports with "Salisbury Cove, Maine" painted upon its stern. In these modern days of steam navigation the village has been outstripped and forgotten, while neighboring communities, through various adventitious causes, have attracted the builders of summer houses by the sea. These places have developed into fashionable summer resorts and have linked their names firmly with Mount Desert Island in the public mind, Salisbury Cove meanwhile remaining quietly in the background. Nevertheless, its ex-

*Curator of the Department of Lower Invertebrates, American Museum

The sand beach viewed from its eastern end. Beneath the bowlders in the foreground congregate numerous nudibranch mollusks and flatworms. A powerful surf breaks on the sandy stretch beyond

cellent harbor, formed by that arm of Frenchman's Bay known as Eastern Bay, is still a safe anchorage for vessels, while its very isolation has preserved a naturally beautiful environment.

From the biologist's standpoint, its situation is exceptional. The sheltered coast line on this side of the island is indented by a succession of coves, floored with sandy mud, and backed by a rocky rampart of cliffs, which jut out at intervals as picturesque headlands covered with spruce growth. The tide rises and falls a distance of twelve feet, so that a considerable stretch of mud flat is laid bare at low tide, where marine worms, clams, crabs, and gastropods abound. The waters of Eastern Bay afford good dredging, and the wharf-piles of the extensive United States coaling station on the shore of the opposite mainland are crowded with marine algæ, ascidians, sea anemones, and sea stars. The deeper waters of Frenchman's Bay are alive with various marine fishes and Crustacea, including lobsters.

South of Bar Harbor there is an excellent sand beach a quarter mile in length, facing the south and the open sea, and protected by the rocky promontories of Great Head and Otter Cliffs. At the eastern end, the low tide exposes a stretch of bowlders rounded by wave action, beneath which numerous nudibranch mollusks (*Onchidoris bilamellata*) and large turbellarian flatworms may be found in quantities. At the western end fragments of rock broken from the cliffs are encrusted with small, edible mussels upon which feed hordes of the gaily colored "purple" sea snail (*Thais lapillus*). Here, on the sand beach, frequent, rounded mounds betray the presence of the burrowing sand-collar snail (*Natica heros*), which at high tide creeps out to hunt razor-shells and clams, its favorite prey. Above the beach rise several forest-covered hills of granite, the most prominent of which, the Beehive, accurately described by its name, is 540 feet in height and affords an excellent view of this part of the coast.

On the eastern shore a large cavern, known as Anemone Cave, has been hollowed out by the waves. On the cave floor, under the shelter of the overhanging roof, many tide pools with quiet, transparent waters are disclosed at low tide. These are the abode of green, red, and brown sea anemones (*Tealia*

Forest-covered hills of granite hem in the beach at either end, the dome-shaped "Beehive" rising in the background. This is a foothill of the picturesque range within which the Lafayette National Park is located

*crassicornis* and *Metridium marginatum*) and the rocky bottoms are completely covered with pink coralline and varicolored encrusting algæ and Bryozoa, while gray-green sponges adorn the sides and fill the crevices. Here and there, amid this profusion, show the orange-yellow slits made by the gaping shells of horse mussels (*Modiola modiola*), the valves of which are so covered by the various marine growths that, when the shells are closed, their presence cannot be detected by the observer.

There are also excellent tide pools near the southern extremity of the island at Ship Harbor and at the Sea Wall. The latter is a natural wall or embankment consisting entirely of small, sea-rounded bowlders, which have been cast up during the winter storms to form a rampart several hundred feet in length and a dozen or more in height. A road crosses this rampart obliquely, but is obliterated by the storms each winter and the following year has to be reconstructed. Below the Wall the shore is of shelving metamorphic rock fractured here and there into quadrangular blocks. Many of these have been torn out by wave action, leaving extensive, rectangular hollows of a peculiarly artificial appearance. These remain flooded at low tide and are occupied by hosts of plants and animals. Pelagic forms—jellyfishes, siphonophores, ctenophores, and salps—swarm in the deeper waters off shore or are blown in upon the coast and stranded.

The oceanic shelf recedes rapidly to depths of one hundred fathoms, where there is an excellent opportunity to secure deep-water forms. The laboratory hopes soon to possess a sea-going boat equipped with the proper facilities to dredge for bottom-living species, and especially for the luminiferous organisms obtainable at such depths, to our knowledge of which Professor Dahlgren has contributed so extensively.

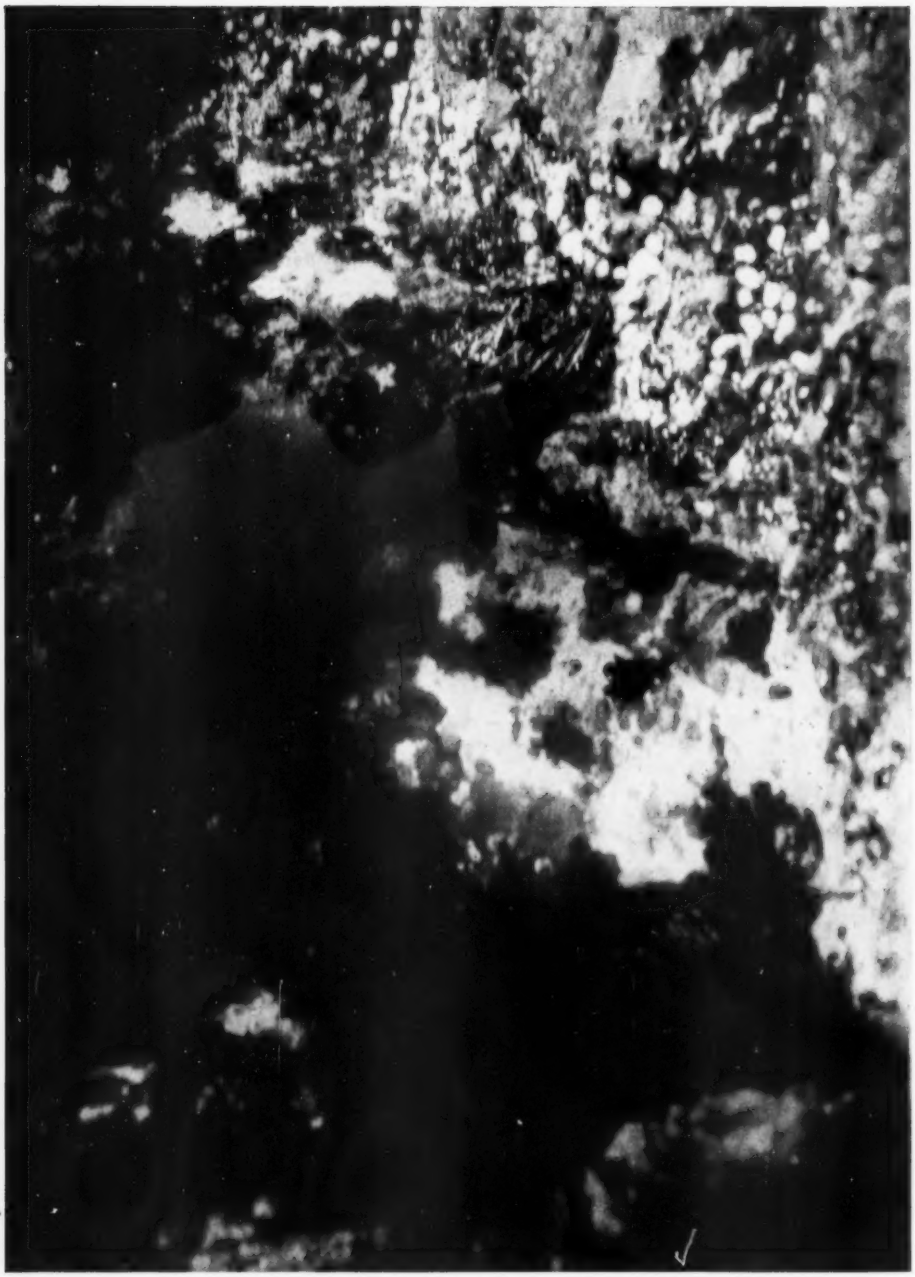
Not only is Mount Desert Island of great interest to the marine biologist, but it presents unusually interesting problems also to the student of fresh-water life, the entomologist, the botanist, and the geologist. To appreciate the significance of this statement, it is necessary to understand the peculiar topography and general geological features of the island. Mount Desert, with an area of one hundred square miles, is the largest rocky island on the coast

Anemone Cave on the eastern shore of Mt. Desert Island. On the cave floor many rock pools are visible at low tide, where sea anemones are abundant; pink corallines, varicolored algæ, and Bryozoa encrust the pool bottoms

Shore near the Harpswell Laboratory, Salisbury Cove, at receding tide. Near by are mud flats where clams, marine worms, and crabs abound. The tide falls a vertical distance of twelve feet

The Sea Wall near the southern extremity of Mt. Desert Island is a natural rampart extending for a distance of several hundred feet along the shore, and consists of rounded bowlders cast up by the storm waves

Below the Sea Wall the shore is of shelving rock, which has been fractured by wave action, so that basins with perpendicular walls are excavated, which the sea transforms into tide pools of unusually transparent waters



A SPONGE-LINED POOL

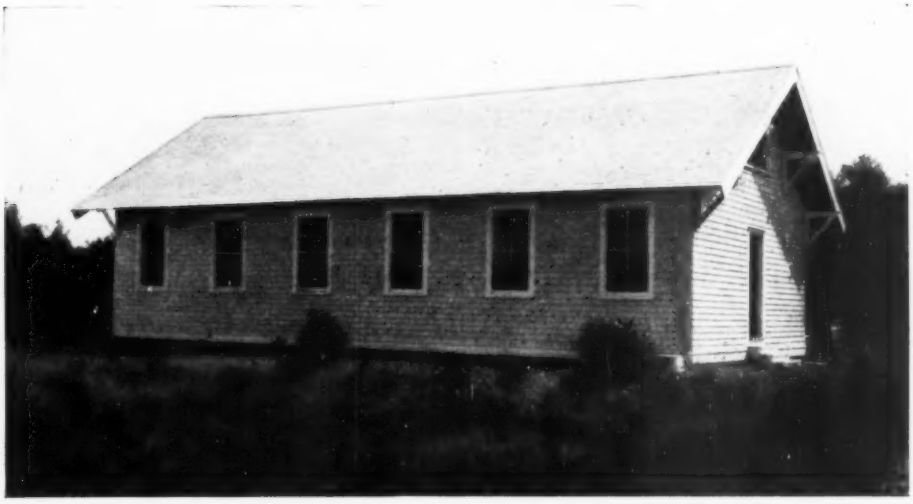
These water-filled rock basins left stranded by the receding tide are focal areas in which the life of the inter-tidal zone mingles with that which is always submerged, resulting in a luxuriant concentration of living forms

A TIDE POOL AT THE SEA WALL

The rectangular walls of these pools give them an almost artificial appearance. The water is so transparent that the margin can hardly be detected in the above photograph. Many sea anemones with extended crown of tentacles can be seen on the pool's bottom

The burrows of the sand-collar snail, *Natica*, may be detected by small, rounded hummocks visible in the sand at low tide. One of the snails, withdrawn into its shell, is seen in the foreground

of New England. Originally a part of the mainland, the shore of which here runs nearly east and west, it is traversed by an interrupted mountainous ridge of granite that before the Ice Age was a continuous wall lying parallel to the coast. During the last glacial invasion, the ice sheet descended upon the island, cutting it off from the mainland and hewing great cross-chasms in the mountain wall, which was thus separated into fragmentary masses, alternating with narrow, peculiarly parallel, north and south valleys. The result is a succession of mountain peaks ranged in an east and west line through the middle of the island. Beautiful lakes, long and narrow in outline, now occupy the valley bottoms; one is 1100 feet above sea level. The mountains rise to various heights, culminating in Green Mountain at 1527 feet. The most central of the long, narrow valleys opens out to the sea, which has completely flooded it, creating a fjord known as Somes Sound. The mountain slopes are forest-covered, but with bare, granite-capped peaks, and afford magnificent views of mountains, lakes, forests, island-broken sea coast, and the open ocean, over which the eye ranges a distance of sixty miles. Through the efforts of public-spirited residents of Bar Harbor and its vicinity, this forested mountain region, so exceptionally located, has been set apart as a wild life sanctuary belonging to the nation, under the name of the Lafayette National Park. The biological investigator and geologist will find this reservation a splendid field for environmental study. It is open to all who love to wander in regions of forest wildness and scenic beauty. The numerous streams and brooks contain trout and an abundance of invertebrate life, including microscopic fresh-water organisms. Entomologists have already found here many insects peculiar in type because of their isolation. Botanists have discovered northern and southern plant forms growing side by side, and such



The initial laboratory building now housing the Weir Mitchell Station of the Harpswell Laboratory, though as yet comparatively small, has accommodations for ten research workers. It is now being provided with pumping apparatus and lighting facilities, and is the nucleus for the projected equipment, which, it is expected, will be fully adequate for carrying on most effective biological instruction and research in northern waters

anomalies in habitat occur as the strictly alpine plant, *Empetrum*, in situations just above the high-tide limit.

In surroundings of such unusual biological interest, the prospects for the development of the newly established station of the Harpswell Laboratory are most propitious. The American Museum has periodically enjoyed the advantages of coöperation with this laboratory in its former location and with the Marine Biological Laboratory at Woods Hole, Massachusetts. During the past season the work of the department of lower invertebrates was greatly facilitated by these two institutions. Marine field work is essential for three reasons: (1) to obtain original material for research, (2) to secure specimens for exhibition and for the study collections, and (3) to make the sketches, photographs, and observations that are required for the groups and models that form the basis of a large proportion of the exhibits in the Darwin Hall. The new station affords a unique opportunity for the extension of this field work along the rocky northern Maine coast, in a region of high tides; on the other hand, the Woods Hole Laboratory is a convenient center for the study of the forms peculiar to a low-lying sand and mud habitat in an environment of comparatively low tides.

Through the courteous coöperation of these institutions and others in the tropics and on the Pacific coast, the Museum hopes greatly to extend its marine coastal work in the immediate future.

# SHACKLETON

BY

ROBERT CUSHMAN MURPHY*

SIR ERNEST SHACKLETON was one of the most popular of explorers. If conceivable, he was even more of a favorite in the United States than in his own country. His idealism, wit, modesty, courage, and staunch loyalty both to his work and to his fellow-men, always held public good will, even though adversity might disrupt the most carefully laid of his polar plans. His was the rare type of personality which compelled mankind to judge his misfortunes only with sympathy. He could fall short of his objective and yet lose neither esteem nor trust.

Shackleton was born at Kilkee, in the south of Ireland, in 1874, the eldest son of a physician. His education at Dulwich College, London, was never completed, because of an irresistible bent for the sea. Before he took part in the transportation of troops during the Boer War, he had sailed four times around the world.

In 1901 he was appointed third lieutenant of the National Antarctic Expedition under command of Robert Falcon Scott, who subsequently testified that, in addition to more rugged virtues, Shackleton's unvarying cheerfulness was a great asset during the whole voyage. In November, 1902, Shackleton accompanied Scott and Dr. Wilson on the first great south polar land journey. For fifty-nine days the three men, with dog sledges, traveled southward across the lifeless continent, where all conditions were totally unknown and unexpectedly severe, reaching 82° 17′ of south latitude before they were obliged to turn back.

Five years later Shackleton organized, largely at his own expense, the British Antarctic Expedition, which proved to be the greatest of his material achievements. On New Year's Day, 1908, he sailed from New Zealand in the small whaler "Nimrod," and proceeded directly to Ross Sea. Among the innovations used on this expedition were eight Manchurian ponies, of which four lived to do good service. The scientific results of the field work were of first importance, the explorers making many excursions and surveys, and discovering an Antarctic fresh-water fauna and a poor but characteristic flora. The outstanding accomplishments of the "Nimrod" party, however, were the ascent to the summit of Mt. Erebus (13,300 ft.) and the exploration of its active crater, the attainment of the south magnetic pole, and the memorable trip on which Shackleton advanced to 88° 23′ south, outdistancing his earlier advance with Scott by a greater step than had ever previously been made toward either pole. The four members of the polar adventure started from Cape Boyd on October 29, 1908. During the southward march three of the Manchurian ponies were successively shot as their strength failed, the flesh being cached for the northward trip. The loss of the last pony in a crevasse was apparently the incident which, by depriving the four men of indispensable food, prevented complete success. On January 9, 1909, Shackleton and his comrades left their sledges and tents, and that day planted British colors on the lofty Antarctic table-land ninety-seven geographical miles from the South Pole.

The return of seven hundred miles to the "Nimrod" was a terrible ordeal. Time and again the four men, who now replaced their beasts at the heavy sledges, ran completely out of food hours before reaching the next depot. They nevertheless hauled out rock specimens from farthest south. Shackleton returned to England without a casualty to report,

*Associate Curator of Maine Birds, American Museum

SIR ERNEST SHACKLETON
A photograph taken after a luncheon of the Explorers' Club of New York, in 1917

and received from the king the first knighthood which had been conferred for Antarctic exploration since the time of Sir James Clark Ross.

The ill-fated Transantarctic Expedition of 1914 was the most elaborately planned of Shackleton's undertakings and at the same time the trip which tested his indomitable spirit to the utmost. As described in *South* it is also one of the most human and stirring of polar experiences. His principal object was to cross the Antarctic Continent from sea to sea. The splendidly equipped steamer "Endurance" met the ice in December, 1914, not far from her first southern base at South Georgia, and, after tracing a part of the continenta-

A panorama of Grytviken, where Shackleton died, and where he is buried. On the spit at the left is the Argentine meteorological station. Behind the coast hills loom the South Georgian Alps, culminating in Mt. Paget (8383 feet)

coast line, was caught in the floes of Weddell Sea, to be held in the pack until she was crushed, ten months later, east of Graham Land. The crew continued to drift, launching their boats in open water only on April 9, 1916. Six days afterward they landed at Elephant Island, of the South Shetland group.

Throughout the long, weary drift Shackleton carried on his person a page torn from the Bible which Queen Alexandra had given the ship. The leaf was from the Book of Job and contained the verse:

> Out of whose womb came the ice?
> And the hoary frost of heaven, who hath gendered it?
> The waters are hid as with a stone,
> And the face of the deep is frozen.

From Elephant Island Shackleton at once set forth upon one of the most remarkable of ocean voyages. At the beginning of Antarctic winter, he and five companions sailed in a twenty-foot boat across a tempestuous and snow-darkened sea toward South Georgia, three hundred miles to the northeastward. After a journey of many days, the terrors and sufferings of which can hardly be exaggerated, the crew of six landed under extraordinary difficulties on the windward coast of South Georgia. Shackleton and two of his men then crossed the all but impassable mountains of the island to the Tonsberg whaling station. This goal attained, he had no time for relaxation. The world is familiar with his three desperate but futile attempts to penetrate the ice pack toward Elephant Island, and with the final and successful effort in a Chilean tug, which resulted in the rescue of the marooned men.

The British Oceanographic and Subantarctic Expedition, of which Shackleton was in command at the time of his death, had strictly scientific rather than polar aims. The "Quest" a vessel of but a hundred tons net, was equipped with wireless, modern instruments for hydrographic work, and a seaplane. Her crew was made up entirely of picked scientific men. Shackleton intended to explore several thousand miles of seacoast, chiefly in the African Quadrant of Antarctica; to search for new coal de-

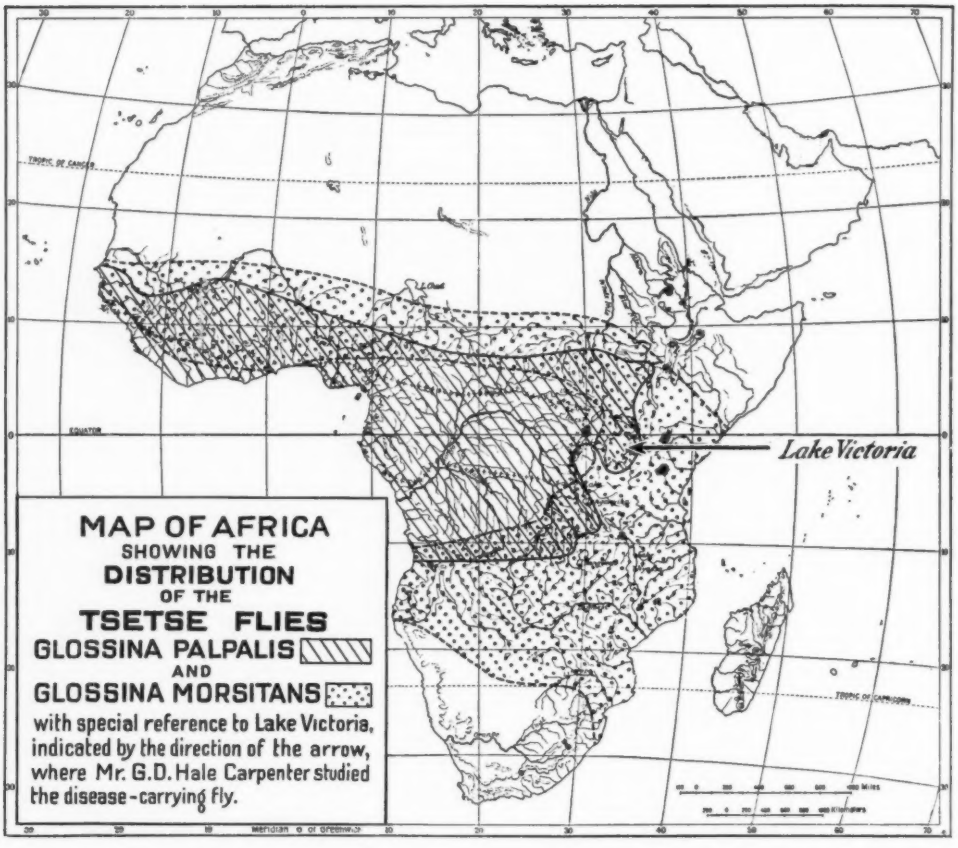
The brig at anchor is the "Daisy," of New Bedford, in the service of the American Museum. At the head of the cove lie the buildings of the *Compañia Argentina de Pesca*, the first modern whaling station in the Far South. Photographed by Robert Cushman Murphy

posits and for harbors which might serve as whaling bases; to find an island suitable for a South Pacific radio station; to make biological collections, gather meteorological and magnetic data, and to carry on extensive oceanic surveys, including deep-sea soundings. Under the able direction of Commander Frank Wild, who has had the best of Antarctic experience with both Shackleton and Mawson, the staff of the "Quest" may yet hope for a large measure of success.

Sir Ernest Shackleton was an honorary fellow of the American Museum of Natural History, and the recipient of many similar honors from learned societies in this country and abroad. Following his return from Scott's voyage, in 1904, he served for a time as secretary of the Scottish Geographical Society of Edinburgh. Other activities not directly concerned with his field exploration include an unsuccessful contest for a seat in Parliament and the direction of military equipment and transport during the North Russia Winter Campaign of 1918–19. He was the author of *The Diary of a Troopship* in addition to his two more widely known books, *The Heart of the Antarctic* and *South*.

On February 15, 1922, which would have been Shackleton's forty-eighth birthday, the rough board coffin in which his body had been brought from South Georgia to Montevideo was placed on an Uruguayan man-of-war to be returned to the icy island which had been associated with some of the most dramatic moments of his career. His interment on the shore of Cumberland Bay, South Georgia, was directed by Lady Shackleton, and was in accordance with the explorer's expressed wish. It is peculiarly fitting that he should rest on the threshold of the Antarctic, for it was at South Georgia that he spoke from his heart, after the moral conquest of 1916, as follows:

"We had 'suffered, starved and triumphed, groveled yet grasped at glory, grown bigger in the fullness of the whole.' We had seen God in His splendors, heard the text that Nature renders. We had reached the naked soul of man."




The tsetse flies (genus *Glossina*), of which some twenty species have been described, are at present restricted to the African continent, south of the Sahara, and to the extreme southwestern corner of Arabia. All species can act as carriers of the germs of various kinds of trypanosome diseases in man and animals, but the map, prepared by Dr. J. Bequaert, shows the distribution of the two which are of foremost importance in this respect.

The area occupied by *Glossina palpalis*, the usual carrier of "African human sleeping sickness," includes the whole of West Africa from the mouth of the Senegal River to Benguela and extends eastward to Lake Victoria. The partiality of this species to the moisture and dense shade of forested river banks accounts for its prevalence throughout the Rain Forest, the limits of which are shown on the map by a light, interrupted line of crosses. Outside this forest belt it is restricted to the well-wooded shores of water-courses and lakes, below 4,000 feet.

*Glossina morsitans*, the fly spreading *nagana* or trypanosomiasis in domestic animals, is a denizen of the savannah country; it avoids the Rain Forest but is found throughout the forested grass plains and low plateaus of the Sudan and East and Central Africa, as far south as the Tropic of Capricorn and Zululand. By predilection its haunts are certain "fly-belts" or patches of thick bush, sometimes of very limited extension and often sharply defined. In certain parts of Rhodesia, *G. morsitans* transmits a very virulent form of sleeping sickness in man, different from the West African and Uganda disease carried by *G. palpalis*

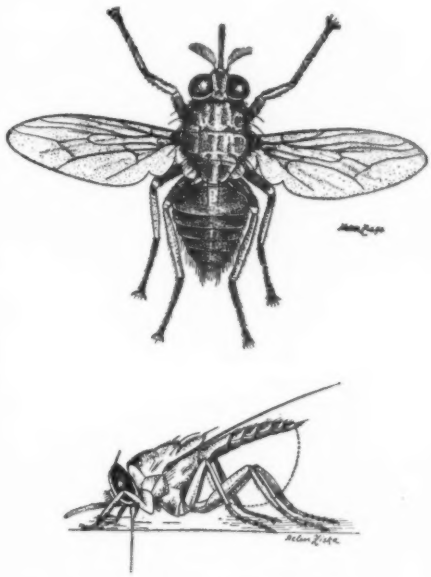
# A NATURALIST ON LAKE VICTORIA: A REVIEW*

BY

JAMES P. CHAPIN[1]

SO NOTEWORTHY a volume on field zoölogy in Uganda as the one by G. D. Hale Carpenter here reviewed could scarcely have a more appropriate title than *A Naturalist on Lake Victoria*. Its purpose is to give an account of the life on the islands of Lake Victoria, and this purpose it fulfills admirably. I have seen it hold the attention of field workers who have carried on similar researches in adjoining regions, and for the general reader it should prove a pleasing introduction to African natural history.

Officially Dr. Carpenter went to Uganda to study the life history and ecology of the tsetse fly, *Glossina palpalis*, the insect that carries the deadliest disease peculiar to Africa,—sleeping sickness. Dr. Carpenter chose a most fitting, if dangerous, spot for his endeavors, the Sesse Islands in the northern part of Lake Victoria, the population of which had been decimated by the pestilence only seven years before. Those natives that survived had been banished subsequently to safer parts of the mainland. Were sleeping sickness an ordinary disease, an uninhabited island might offer little risk to a new arrival. The fact is, however, that the germ of this disease, a flagellate protozoan known to science as *Trypanosoma gambiense*, continues to multiply in the blood of infected şitatunga antelopes, causing no harm to the beasts, yet preserving its deadly virulence to man if transferred to his blood by the biting tsetse fly, the dangerous intermediary. Unless the antelope can be entirely destroyed throughout the region—and provided always that no other animal is found to harbor the dread *Trypanosoma*—the Sesse Islands will probably remain uninhabitable, for as yet no radical therapeutic control of the disease is possible and extermination of the fly hardly likely. This will give some hint of the risks undertaken by an entomologist making the tsetse his special subject,—risks confirmed by the subsequent infection of three of Carpenter's native employees with *Trypanosoma gambiense*.



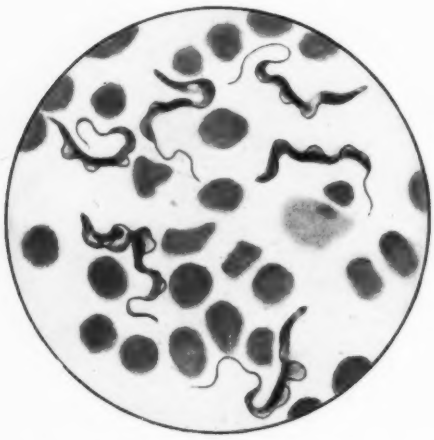
*Glossina palpalis*, the usual carrier of African human sleeping sickness. (Enlarged to almost three times natural size.) Above, fly with wings extended; at rest the wings are folded scissor-like above the abdomen. Below, fly in biting position; the dotted line indicates the extent to which the abdomen swells when the fly has fed to repletion

Two most instructive chapters are devoted to the natural history of the disease and its carriers, with special emphasis on the supposed origin of try-

*A Naturalist on Lake Victoria. By G. D. Hale Carpenter. With 2 colored plates, a map, charts, and 87 illustrations, pp. I-XXIV, 1-333. New York, 1920, E. P. Dutton & Co.

[1]Assistant Curator of African Birds, American Museum

panosomiasis and the possibility of destroying an essential link in the vicious cycle of infection and reinfection, namely the fly. All trypanosomes are not pathogenic; they are found all over the world, especially in the blood of vertebrates and in the digestive tracts of invertebrates, but only in the case of relatively few trypanosomes can it be shown that they cause any ill to the host. Well do I remember our interest at college when our professor broke off the end of the tail of a common American newt, to show us the large trypanosomes swimming corkscrew-like in the drop of blood that exuded. The newt, like so many



Stained preparation of blood showing the germs of African human sleeping sickness (*Trypanosoma gambiense*). Magnified 900 times. (After Roubaud)

other animals, has developed a virtual immunity from its particular breed of trypanosome, and man is not affected by that species causing *nagana*, a deadly affection in cattle. But one's interest is of a very different sort from that experienced in the college class room when the doctor, examining one's caravan of African porters, feels for enlarged lymphatic glands in the neck, an early symptom of sleeping sickness. One is apt to go off fingering one's own neck and wondering how many tsetse bites, according to the law of probabilities, will make a case of disease. Carpenter tells us happily that in Uganda only from 2 to 11 per cent of *Glossina palpalis* were found to contain trypanosomes, but these trypanosomes included two species harmless to man, and of course there is many a chance that a possible infection may not "take."

*Glossina palpalis* is a good illustration of the influence of vegetation and humidity on the distribution of animal life in Africa, for, as shown on the accompanying map, the insect occurs only in the "West African" subregion, on the eastern edge of which lies Uganda. So the center of dispersal both of fly and disease may be said to lie rather in the Congo basin; and the reason for this limited distribution is seen in the necessity of a certain temperature and abundant moisture for the development of the pupæ as well as for the comfort of the adult fly. Yet the related *Glossina morsitans*, carrier of *nagana*, is just as typically a "savanna" creature, shunning the denser forests, although requiring very definite conditions of shade and humidity for its pupal development.

Carpenter's exact methods of studying the abundance of adult flies were based on the average number that could be caught by one black boy in an hour. Since the females when not hungry are less active than the males, the best index to conditions is the abundance of male flies, which may attain 125 per "boy-hour." If to this capture of males were added the females caught during a similar interval of time, the total would be increased by at least one fourth. A locality so thickly infested would not be a very comfortable one in which to tarry, but the figure cited is a maximum and the species in question does not feed at night. The other species of *Glossina* that do occasionally bite at night are far from common. During two years in the Ituri District I was bitten on only two occasions by

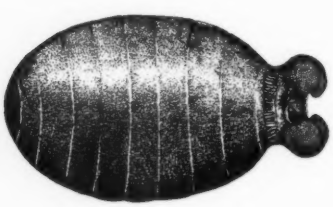
*Photographs by H. Lang*

To the left, a fine adult male of the West African sitatunga (*Tragelaphus spekii gratus*), a close relative of the form which in Uganda plays so important a part as a reservoir or natural host of the germ of sleeping sickness. Though widely distributed along certain swampy portions of the Congo basin, Cameroon, and Angola, these antelopes are rare in collections. To the right, a picture of their typical haunts on the Bima River in the southern Uele District, Belgian Congo. These antelopes can spread wide their long hoofs, thus preventing their sinking too deeply into the muddy ground while browsing on various plants of the undergrowth along the forest brooks

tsetse at night, and on those occasions I was carrying a lantern.

Since the secondary host of the sleeping sickness "germ," so far as known, is always a mammal, it is important to know the percentage of mammalian blood in the food of the tsetse. This varied, Mr. Carpenter states, according to the abundance or absence of mammals on islands or mainland from 4 to 31.5 per cent, but the principal source of food, as proved by measuring the red corpuscles in the stomachs of flies, turned out to be the monitor (*Varanus niloticus*), with the crocodile a close second, and avian blood twenty-five times scarcer than reptilian.

Even if the sitatunga antelope above referred to could be exterminated, which Carpenter doubts, other mammalian hosts might be found, and it seems simpler to aim at the extinction of the fly. The natural checks on its multiplication, either parasitic or predaceous, do not seem sufficient to accomplish such a result, indeed it could hardly be hoped for. Birds do not often eat the adult flies, as I can state also from experience in the Congo, for the examination of some five thousand stomachs taken from more than six hundred species of birds did not reveal a single tsetse so far as my rather hasty examination brought out. If any African birds do eat the tsetse, however, it should be the gray, riverside flycatcher of West and Central Africa, *Alseonax lugens*, and the swallow, *Hirundo nigrita*, which I recommend for special investigation by future workers.



Pupa of *Glossina palpalis* showing the two tumid lips enclosing a deep pit at the posterior extremity. These protuberances are typical of the pupæ of all tsetse flies

Cutting off the forest and even low brush from the moist areas near habitations and roads has long been recommended and even practised in parts of equatorial Africa, for the control of the tsetse fly,—a course of action based upon the predilection of the adult fly and pupa for moisture and shade. Unlike most other flies, the species of Glossinæ do not lay eggs, but are viviparous, giving birth to a few, large, active larvæ, which immediately burrow into the soil and pupate. In the case of *Glossina palpalis*, the requirements of these pupæ are briefly summarized by Carpenter as follows: "Loose, dry soil, well shaded, but with the surface thoroughly ventilated; within a few yards from the water but beyond its reach." Spots meeting all the requirements are often much rarer than one might expect. Especially is this true within the confines of the great Congo forests, as in the central Ituri, where sleeping sickness has never taken hold. A sitatunga is found there, but neither are the flies very numerous nor is the human population very dense.

Carpenter proposes an ingenious method of destruction. Construct low, thatched shelters, he says, that will offer ideal conditions for the flies to deposit their young, then collect and destroy the pupæ at regular intervals. He has reason to believe that even the natural "loci" will be abandoned in favor of the more tempting artificial ones and that really valuable results may thus be secured. The whole idea is based, of course, on the abnormally slow breeding of the *Glossina*, a single egg being hatched within the abdomen of the mother and the larva fed by the secretion of special glands before it is finally extruded; in the case of almost any other fly the proposed procedure would seem ridiculous; but no one, it may confidently be stated, is a better judge in this matter than Dr. Carpenter himself.

*Photograph by H. Lang*

Typical breeding grounds of *Glossina palpalis* on an island in the Congo River near Zambi. Among dry leaves on the deeply shaded, raised river bank the gravid female flies deposit their full-grown larvæ one at a time; these burrow in the underlying layer of loose sand, pupate at once, and develop into adult flies about three weeks later

Besides considering the sleeping sickness question and the general natural history of Lake Victoria, Dr. Carpenter has somewhat of an ax to grind, not entirely his own, since it is concerned with mimicry among insects, especially Lepidoptera, with which Professor E. B. Poulton and Dr. Karl Jordan have been so prominently identified. Professor Poulton has written a preface for *A Naturalist on Lake Victoria*. Among the points of greatest interest he lists the investigations of Dr. Carpenter concerning *Papilio dardanus*, a swallow-tail butterfly with a typical male but frequently with very different females mimicking certain other common butterflies of the regions in question, and Dr. Carpenter's confirmation, by breeding experiments, of Dr. Jordan's conclusions with regard to *Pseudacræa eurytus*, a single highly variable species of butterfly producing a wonderful series of mimics that copy certain other butterflies in different regions.

The reasons for mimicry among insects are still in dispute, its exact operation is still a subject of debate, but the superficial resemblances often seen between comparatively unrelated groups fall little short of the marvelous. It was H. W. Bates who first attempted an explanation of the subject, based on the fact that true mimics are very conspicuous in their natural surroundings, and that the models are common but supposedly distasteful species.

This question of mimicry is a subject quite distinct from that of protective coloration, of which so much has been written in America, stimulated particularly by the Thayers, and which Carpenter also discusses. In spite of the statements so often repeated, Gerald Thayer does not, of course, believe every animal to be protectively colored, any more than could those who have so often dissented from his views pretend that no animal is protectively colored. All of us have been struck by extreme examples

of "procryptic coloration," as Poulton has termed it; and on the other hand, entomologists have long wondered at the parallel series of Lepidoptera which one can assemble in any tropical country, nay even in temperate climes, for North America has its milkweed butterfly (*Danaus archippus*) and its mimic (*Basilarchia archippus*), the one abundant[1] and evidently distasteful to birds, the other belonging to a different family yet strikingly similar in color, pattern, and general outline. The presumption is that the whole group to which the mimic is genetically related is preyed upon by birds and other enemies, but the mimic itself escapes their unwelcome attentions when once they have learned the disagreeable taste of its model.

For a long time, therefore, natural selection has been invoked to explain the survival, if not the origin, of the models and their mimics, the latter being selected, because of the above-mentioned advantages, from random variations in color. Those which closely resembled distasteful species were spared, the less-favored variants were consumed, leaving fewer and fewer offspring till definite mimetic strains became established.

What are the special enemies from which mimicry in butterflies protects the mimics? The triangular notches so often observed in butterflies' wings are doubtless in many cases the marks of birds' beaks, yet it has been denied—even by field naturalists—that birds eat butterflies in any appreciable numbers. The late F. C. Selous remarked that in Africa he did not once see a bird eat a butterfly; but he could scarcely have watched the African wagtails with much attention. These terrestrial birds eat insects and their larvæ in great variety, seizing flies in the air with an audible snap of the beak; they very frequently take butterflies, and may be seen shaking them vigorously to get rid of the wings. Many butterflies have a tendency to crowd in damp spots near water; consequently as one crosses a brook along an African trail, detached butterfly wings are often seen on the banks,—discarded fragments of the feast enjoyed by the wagtails. Even in the stomach of a heron (*Ardeola ralloides*) I have found as many as twenty small butterflies.

*Photograph by H. Lang*

African pied wagtail (*Motacilla vidua*).—Professor Poulton's disciples contend that this bird is one of the most potent factors in the production of mimetic forms among butterflies, insects on which it preys extensively. Doctor Carpenter relates how he observed the wagtail taking its pick from a mixed assemblage of butterflies that had alighted on the ground. He states that it never attempted to eat the members of certain groups reputed to be distasteful

[1]During the past three years this insect popularly known as the monarch has been of very limited occurrence in the neighborhood of New York. See NATURAL HISTORY for July-August, 1921, p. 438.

Marshall, Swynnerton, and Carpenter have all furnished abundant evidence that in Africa birds do eat butterflies. Doubtless much remains to be done toward establishing definite preferences on the part of the birds, but that they prey on butterflies can no longer be denied.

Since the development of the theory of mutation and studies in Mendelian inheritance, some doubt has arisen as to the continuous, random variation in color among the prospective mimics. It might be that the various mimetic lines are the direct result of mutation, and that these forms, if crossed, do not blend, but simply reassort their characters, always remaining clearly distinct. In such a case natural selection would not be essential to explain the similarity between model and mimic; this might be purely fortuitous, or the result of some factor, genetic or environmental, which caused parallel mutations in both series.

As Carpenter is a disciple of Poulton, one might expect him to combat the mutationist view, and this he does with considerable skill, not from an "armchair" point of view but as a most observant field naturalist. He relates the details of many observations and experiments to prove the reality and effectiveness of "aposematic" or warning coloration, and then, to show that species possessing such advantages have, nevertheless, many enemies to hold them in check, he states the case for any particular species of insect which is holding its own, without marked increase or decrease. The same number of individuals must continue to survive their combined enemies, vertebrates, predacious and parasitic insects, and the microörganisms of disease. If warning coloration or distasteful odor protects a species from vertebrates, it may almost be taken for granted that some of its other enemies are more menacing. Such a species, without this partial protection would doubtless already have been exterminated.

If insects not distasteful in themselves derive an advantage from a close resemblance to distasteful forms, it seems also likely that two distasteful species are better protected by the possession of a common warning color, especially if their enemies must learn their disagreeable qualities by experiment instead of avoiding them instinctively. A bold marking with orange-brown and black, is a type of coloration found through many orders of insects both in Africa and the East Indies, and has been named "lycoid" from a family of distasteful beetles that possesses it.

Since the butterfly genus *Pseudacræa*, which Carpenter studied especially, is believed to be partially distasteful to birds, he is obliged to admit that its resemblance to acræines and danaines, which are more pronouncedly distasteful, may be considered as a transition between common warning colors and mimetic. Briefly stated the case is as follows: a single polymorphic species *eurytus*, of the genus *Pseudacræa*, was formerly believed to represent seven distinct species (thirteen named forms in all), and imitates thirteen distinct species of *Planema*, among the acræinæ. In practically every case model and mimic have been found in the same localities.

The idea that all these forms of *Pseudacræa* must belong to a single species first occurred to Dr. Karl Jordan in 1910 after an examination of the male genitalia, and its proof was delegated to Carpenter by Professor Poulton. A few intermediates had been found, to be sure, between some of the forms, but these were rare until Carpenter began collecting on the islands in Lake Victoria. Here transitional forms were found in numbers, and the *Planema* models were relatively scarce. Between these two facts Professor Poulton saw a causal relation: where the models are of comparatively rare occurrence, the intensity of selection affecting the mimics must be relaxed, allowing intermediates to survive. This was tested out by Carpenter

in a statistical study which shows that the proportion of intermediates between strictly mimetic forms of *Pseudacræa* varies inversely as the proportion of *Planema* models in the total captures of butterflies.[1] For this purpose, of course, all the specimens observed must be caught and counted indiscriminately. Just why *Planema* should not thrive on the islands of Lake Victoria cannot be completely explained; but the relative scarcity of insectivorous birds on some of the islands may also play a part in the working out of selection.

The direct proof of specific identity for these forms of *Pseudacræa eurytus* was secured by rearing broods from nine different females. Among these broods were found not only many intermediates, but also offspring quite different from the female parent, two different "races" or even more intermediates sometimes appearing from eggs of a single female. In all cases the male parent was unknown, for it was not possible to mate the butterflies in confinement, and even then the experiments had to be carried on in the forest to avoid fatalities from lack of humidity. Exact genetic data could not, therefore, be secured; it was simply shown that the named varieties were not Mendelian entities, or at least not single factor differences.

Too much emphasis is laid, perhaps, on the difference between the Darwinian and mutationist points of view. Heritable Mendelian characters may certainly differ so slightly at times as to approach fluctuating or "continuous" variations, and in any event it may be stated that Carpenter has presented an excellent case for the operation of natural selection in the origin of *Pseudacræa* mimics.

The eight other chapters of Carpenter's delightful volume are devoted to a general description of Lake Victoria and its animal life. They are not arranged primarily in narrative form, but classified rather as to subject. This has its advantages, for it makes the reference to certain groups of animals more feasible. Take, for example, the chapter on birds, which naturally interested me as an ornithologist most of all, since the birds of Uganda and of the eastern Congo are in so many cases the same. Dr. Carpenter has especially disclaimed intimate knowledge of vertebrate zoölogy, ornithology in particular, yet he has a vivid way of describing the appearance and habits of Uganda birds that would do credit to a book dealing only with the birds of that region. A semipopular book on Central African birds is heartily to be desired; in 1911 the van Someren brothers attempted this for a score of the commoner species,[2] and we fervently wish they could extend it so as to cover a larger part of the abundant avifauna. How much more would travelers and sportsmen observe and report to the scientific world if their interest could be stimulated by a portable, readable work of this sort.

When the author attempts to apply Poulton's theory of aposematic coloration and behavior to a large hornbill (*Bycanistes subcylindricus*) I am forced to dissent. This bird can display itself openly because of its large size, and a peck from its enormous beak would suffice to keep any bird of equal size at a distance. I am not sure that hornbills are as a rule distasteful, I have known *Ortholophus cassini* in the Ituri Forest to be killed and eaten by a hawk no larger than itself (*Astur toussenelii*).

The chapter on mammals is written in the vein of the animal lover rather than in the spirit of the hunter. In it will be found an excellent study of the "speech" of one species of monkey, a common *Cercopithecus* living on the larger islands of the lake. This well shows the extent to which a monkey can express its feelings by sound, and is far more convincing than all that a more widely known writer

[1] On p. 267, of his volume Carpenter offers a very convincing chart covering this point.

[2] *Studies of Birdlife in Uganda*, London, 1911, 22 pages, 25 plates.

on the subject has ever been able to tell us. After all, monkey language is very different from articulate human speech and its range is comparatively limited, fourteen different sounds being listed in the present instance. It is a prime requisite in such studies that each species be studied individually, for as any naturalist knows who has visited Africa, the calls of monkeys are just as distinct, specifically, as are those of birds.

The period covered by Dr. Carpenter's book was unfortunately interrupted for four years by his active service with the Army in East Africa, and of his observations during this time he gives us scarcely a word. Perhaps it is not too much to hope that he may be preparing a second volume about those experiences, and in such a case, we may well guarantee it a hearty welcome.

*Photograph by H. Lang*

Segregation camp for sleeping sickness patients at Aba, near the northeastern frontier of the Belgian Congo. The small brick houses in which the patients are isolated have been built on high ground away from any watercourse where tsetse flies might live, so that none of these insects can become infected with the trypanosome and thus transmit the disease from sick to healthy natives. For the same reason the brush and trees which could shelter tsetses, have been cut away

AHUREI BAY

As one looks to the east from a vantage point on one of the old hill forts on Rapa Island, this beautiful enclosed bay, with scattered taro beds growing on its southern shore, shows clearly

# A VISIT TO RAPA ISLAND IN SOUTHERN POLYNESIA

BY
ROLLO H. BECK*

RAPA ISLAND, the most southern of the Eastern Polynesian Islands, was one of the places I wanted to visit, and the good ship "Pro Patria" was the means of reaching it. After several weeks of sailing, broken only by three landings made on islands of the Austral group, I was glad to step ashore on Rapa one April morning last year. The hour was fairly early, but the islanders were already astir, preparing the morning meal. Obstructing my line of march were taro beds, where the mud in places reached above the ankle; so, slipping off my shoes and shouldering my camera, I started barefooted over the uninviting ground. After wading through the last mud puddle I washed my feet in a clear stream of water, put on my tennis shoes, and started off on a well-marked trail through the coffee trees toward the ancient fort that was my objective.

Above and some distance beyond the coffee trees I passed several little patches of taro. A few dozen plants growing on a leveled place in the steep cañon reminded me of potato patches I had seen in Peru in 1913, where a dozen plants, protected by a well-built stone wall of Inca origin, sometimes constituted the entire crop. Banana plants in groups of twenty or more were distributed here and there in the cañon. Coffee trees were growing on a low level, near its mouth, whereas in most places they grow well up on the hillsides.

Climbing up, knee-deep, through ferns, I soon reached the top of the ridge near the fort, toward which in bygone days others had marched with more sinister intent. Four different levels on top of the ridge had been protected by built-up rockwork and on the highest point a solidly constructed wall had been erected as a last stronghold. Just below the top on a leveled terrace 40 x 40 feet, a small hole had been dug, probably to catch rain water.

Four miles away in an air line, two other forts showed up against the sky. All were so built that if besieged a small force within could hold at bay an attacking force several times its number, provided food and water held out. The only approach was by the ridge, as the sides of the mountain were too steep to climb.

Down to the eastward, the beautiful enclosed bay of Ahurei, with the scattered taro beds lining the head of it, showed clearly, while high above the village wild goats could be distinguished ranging the craggy tops of the ridge. Just to the southward of the fort the ridge runs up to nearly 2000 feet, forming a sharp backbone of unclimbable cliffs, while to the west and north other ridges with narrow valleys between cut the island into sharply defined districts. Wild pigeons were cooing in the cañons below as I descended and stopped, after the steep climb, to refresh myself with a bath in a rocky, water-worn basin, prior to my returning aboard the "Pro Patria," there to change to Sunday gear before joining the crew ashore for luncheon.

I found the captain and his wife, the mate and his wife, and the supercargo enjoying the garden of the French administrator, where a bearing fig tree and orange trees weighted with juicy fruit invited attention. In another month the ripening oranges would no doubt furnish a pleasant addition to the meals of poipoi, the principal food of the islanders. A splendid crop of tobacco was maturing in a small grove and bore witness to the rich soil and favorable temperature.

*Leader, Whitney South Sea Expedition

While we lingered in the garden, the chief's son, his wife, and two daughters, arrived to lead us to his residence. In our walk thither we were followed by a dozen of the ubiquitous children of the island, some in shirts, some in *pareus*, one in the discarded vest of some itinerant visitor, and several of the younger wearing nothing at all. As we entered what I supposed was the residence of the chief's son, the supercargo warned us to eat lightly as we would be expected to partake of food at several other places as well.

Fresh banana leaves were laid in a long row across the mat-covered floor and at each place was a plate containing one or two whole fish, a plate containing several large pieces of juicy pork, and at one side of the plates a large taro root. Sitting down in the most comfortable position on the mat, we ate with the aid of our fingers, for at none of the houses were the common table accessories known to civilization provided. As the first few pieces of fish gave way to the pork, the serving maids brought in the poipoi neatly enclosed in the broad green leaves of the rauti plant. The poipoi looked to me like wet, sticky dough with a lot of yeast in it, and that is the way it felt too. As this was my first experience with the food, I nibbled it rather gingerly, but the rest of the party, using two fingers as tongs, would separate from the mass a good big finger-load and, holding this deftly poised for a moment before the open mouth, would presently gulp it down with the aid of a swallow of water. Opposite to me a girl grasped a handful from the quantity lying on the leaves, dropped it into a bowl of water, and, dividing it into four pieces, swallowed the several morsels in the space of not more than ten seconds.

While we were still engaged in eating, the son of the chief appeared in the doorway and advised us to hurry, as dinner was awaiting us at his home. So, leaving the untasted residue of the feast, we walked across the lane to his abode where a similar repast awaited us. In addition to the fish, however, there was a lobster cooked whole, and in place of one taro root, there were two large ones. A tumbler of water, too, was provided for each guest. The meal was well under way when the captain leaned back from his partly eaten lobster, which had been about two feet long in life, and, in deference to his leadership we all slacked up and presently ceased eating.

We passed out along the lane to a smaller thatched cottage and found within a repetition of the repast offered at the houses previously visited, except that in place of the pork, a deliciously cooked chicken had been prepared. The supercargo again reminded us not to eat too much as we would need a reserve of appetite at the chief's place, to be visited next. When presently we strolled up to his large hut, the chief was awaiting us with his wife and three or four girls in the open yard before the door.

In this home again lobster, pork, and chicken were waiting—as a last test of our capacity. The amount of taro had increased to three big roots, although a few pieces broken off the small end of one root would easily have sufficed for a meal. In addition, the chief had coconut milk in which to dip the meat and roots, a rare dish in Rapa, as coconuts are not grown there and nuts are obtained only when a ship from the northern islands calls, which happens but seldom. We were also served with molasses, not greatly dissimilar in looks and taste to the dark cane molasses used largely for cooking in the United States. This local syrup is made from the roots of the rauti plant, the leaves of which are used to wrap the poipoi in, as well as fish, fowl, and other meats cooked on hot rocks. The molasses was placed on the plate with the poipoi, and we found that the poipoi could be more easily swallowed with the aid of the dark fluid than with that of water, the usual liquid taken with the pasty substance.

At the conclusion of the meal, bananas were passed around. While the others lit cigarettes and talked, I sat back and watched the changing assemblage of children in front of the open door and window, waiting for a favorable moment to pick up the graflex and take their pictures unawares. The chief, from his seat at the head of the table, watched with great interest the proceeding, and when we arose to go, he stepped outside with us and made it possible for me to take a picture of him and his family, with the younger members of several other families.

Although we had been told the population of the island did not exceed forty, we saw more than twice that number of individuals. The people are a hardy, energetic lot, the women working in the taro beds, while the men row several miles on their fishing trips. They obtain a variety of edible fish if the catches we saw on Saturday and Sunday, consisting of many specimens of different color and shape, are any criterion. While on board the "Pro Patria" one day, I was amused to see a fellow passenger, the former French Commissioner at Rurutu, fishing from the stern of the vessel and catching nothing, while tied alongside was an outrigger canoe with an old, decrepit native in it pulling up a sizable fish every few minutes.

A few of the fishermen, for our benefit probably, made a trip to the lobster beds at the entrance to the bay, and brought back a hundred lobsters to be cooked at the several houses we visited Sunday. Practically every house in the village entertained one or more of the crew during our stay of five days and after the luncheons and dinners of Sunday had been digested, the captain suggested that it would be a courteous act to present a case of kerosene for use in the church, the light of which shows up brightly as a ship enters the harbor. The next day a case of kerosene was taken ashore and delivered to the caretaker of the church. That the captain's gift was appreciated was proved the day we left the island, for package after package of poipoi was presented at the wharf by the families belonging to the church.

A GROWTH OF PAPAYA
This picture was taken in the Tubuai Islands

The taro plant, from which the poipoi is made, grows best in shallow water, somewhat after the manner of rice, though it is a plant of an entirely different character, looking like a big lily root when pulled from the ground or mud. The amount of work necessary to keep the beds free from grass becomes apparent when one contrasts the condition of beds temporarily abandoned with that of beds taken care of, and is proof of the industry of the women who tend them. The younger women and girls do most of the field work, while the older ones attend to the cooking at home.

On Rapa, food is cooked, as a rule, not indoors, but in the front yard

The boathouses as well as the family houses of the island are heavily covered with a roofing of thick grass

This conical structure, with its thick matting of grass, so suggestive of a haystack, is a native dwelling. Orange trees are a familiar sight near such habitations

The chief, the members of his family, and sundry young subjects ranged themselves in front of the chief's house so that the writer might photograph them

AN EXCHANGE OF GREETINGS

Daily the women and children paddle unstable-looking canoes to and from the taro beds on the northern shore of Ahurei Bay

EVENING CALM

From childhood the people of Rapa are trained to the life of the sea. Women as well as men are expert in handling canoes

At Rimitara and Rurutu islands, some hundreds of miles to the northwest of Rapa, the work of the women is limited largely to the making of mats and hats, while the men labor in the fields. At Rapa, however, the preponderance of women gives the men an enviable position. The exemption of the men from field work allows them more time for fishing and as a result of the sea experience thus gained they are much sought after by the captains of sailing vessels in Papeete.

We were astonished at the performance of the boat crews that came out to meet us three or four miles from the island. These crews had made no allowance for the fact that we had an engine that enabled us to speed up our sailing, and in less than a minute they were left a hundred yards astern. But when our cabin boy, a Rapa man, called to them to come up and be towed in they showed what they really could do, and though we were traveling at the rate of about six miles an hour, they were moving in the open sea at twice that speed when they neared the vessel.

A couple of instances noted during our short stay shows how they get their sea experience. One day I engaged a crew to row me about five miles to an islet where certain sea birds nested. Two of the members of this crew were only about thirteen years of age. However, we started out and, before reaching the ship again in the late afternoon ran into a heavy storm. The boys managed their oars during the hours of pulling against a head wind and rising sea as though they had been accustomed to the work for years. I frequently had to bail water from the boat, helping the youngster at the after-oar in the intervals, for he was handling an oar weighing about fifty pounds and the oar was poorly balanced—most of the oars being home-made and of native wood.

The day following this excursion we were on board the "Pro Patria," ready and expecting to sail, but the pilot and the barometer advised remaining at anchor. By three o'clock in the afternoon, with both anchors down and engine working, we were slowly drifting toward the rocky shore at the head of the bay, when a gust of wind a trifle heavier than that sweeping a pall of smoky-looking water across the surface of the bay caught the twenty-four-foot boat belonging to the pilot, which was fastened by a long line astern of us, and in a twinkling flipped it bottom-side up. The son of the chief, who was steersman, called to two of his crew and, pulling the overturned boat a little nearer the schooner, jumped with them into the bay, swam to the boat and, aided by his men, presently turned it over into its proper position. Thereupon the pilot cast the boat adrift and, with the three mariners clinging to it, it drifted to the shore, a few hundred yards astern of us. Arrived in shallow water, they managed to bail it out in an hour's time and then returned to the ship, in the face of a gale which was tearing in terrific gusts down from the mountainside.

We were somewhat surprised to see how extensively the unstable-looking canoes were used by girls and women, who several times paddled past the ship on their way to the taro beds a couple of miles across the harbor. In the evening they would return with a load of heavy taro roots weighing down the narrow canoe very nearly to the sinking point. From childhood these people become familiar with the ocean. A shallow depth of water stretches along the shore by the village and on sunny days children can be seen at all hours paddling canoes or playing in the water alongside the stone pier.

The whole population of the island, exclusive of a few lepers, who were confined to another valley, was living in this village or along the bay shore within a couple of miles of it. Five or six valleys that formerly supported villages are now deserted, but the stone forts

WHERE BANANAS AND TARO GROW

It is of taro that the natives make poipoi,—a dish relished by Polynesians but by few others. Because of its broad leaf, the taro plant is known in some places by the not inappropriate name of "elephant's ear." This picture was taken on Rimitara Island

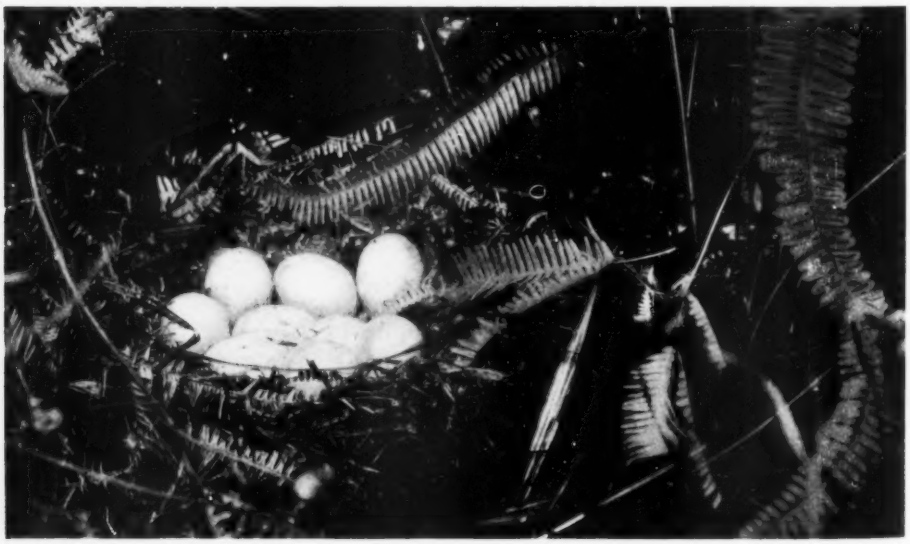
that protected the people living in those villages, still stand on the hilltops and can be seen from the sea as a vessel nears the land.

The second day after our arrival I went ashore early and passed the church on my way to the mountains just as the people were gathering for one of the tri-weekly morning services. A boy about twelve years of age espied me and, detaching himself from the crowd, raced after me and accompanied me or led me up and down a devious route till our return in the evening. We passed over the first ridge and then swung around and up the valley toward the center of the island, dipping down into little gullies where orange and lemon trees were growing beside shiny-leaved coffee trees, with groups of banana plants in the moister places, till we crossed the main cañon more than a mile from the sea. We found groves containing a few dozen coffee trees in the most unexpected places, among tree and brake ferns; these coffee trees had been planted in some depression after a fairly level spot had been cleared of underbrush and ferns.

In the bottom of the main cañon small beds of taro extended up into the narrow, rocky portion at the base of steep cliffs, two miles or more from the village on the other side of a high ridge. Why these beds should have been planted so far from the living quarters was puzzling, for there was considerable idle ground suitable for agricultural purposes much nearer the settlement, but possibly dry seasons made it necessary to have reserve beds near a reliable water supply.

We climbed upward from this cañon a thousand feet to the top of the next ridge and there, standing on top of one of the old grass-covered forts, I shot one of the native, green, fruit pigeons, the species on Rapa being the largest of the several species found on different Polynesian islands. As far as we could learn, it is the only native land bird, provided the cuckoo, which also occurs, is a migratory visitant from New Zealand, as it is believed to be.

As we worked down the razor-backed ridge, the barefooted boy would skip along over places on the goat trail that I would negotiate with extreme care.



The nest of the wild duck that inhabits several of the Polynesian Islands is found but rarely, as it is usually placed on a hillside some distance from the water. This nest was located in a thick patch of ferns

Thus by rapid stages we descended until we reached the shore, going past patches of forests on hillsides, where calling for pigeons would sometimes elicit answers from birds in the dense trees but seldom would induce the birds to come into view. There we found a clump of orange trees growing near an old hut used by the workers in the taro beds near by. We picked some of the oranges and ate them. Then we tackled another steep mountain-side where a forested area gave promise of pigeons, but the dense growth prevented our seeing them at a distance and we secured only one bird, making but two specimens for the day's trip. During our stay we managed to capture a dozen pigeons and several of the little black rails that live in the thick grass and feed in the open taro beds, the only places where they can be seen.

Early in the morning of what I supposed was to be the last day of our stay, I hastened ashore with the camera to get a photograph of a duck's nest which I had discovered a couple of days before. The crew of the rowboat meanwhile was busy taking on board the last sacks of coffee and a dozen goats caught by the natives in the mountains. These goats had been bought for the absurdly low sum of seven and a half francs each.

When I returned at ten o'clock, the boat was still being loaded with coffee, goats, poipoi, taro, baskets, and gourds, and every few minutes a woman would bring down yet another package. This continued up to eleven o'clock, when the rowboat made its last trip.

As we stepped aboard the "Pro Patria," a heavy rain began. Instead of setting sail as planned, we stayed in the harbor, fighting all afternoon the wind that, with hurricane force, swept across the water. Toward evening the storm abated and the following day we got under way and passing out of the narrow channel arrived abreast of Rapaita, the small islet just off the outer point of the harbor. There the pilot said "Fine," and relinquished the wheel to one of the crew. As the pilot called to his crew, "Harrimai pote" ("Come along to the boat"), the captain called out, "Fore staysail," and the pilot descended to the cabin to receive his pay. Presently he returned smiling to the deck, then dropped into his boat, which was pitching on the water alongside. As the pilot's boat dropped astern, the crew waved hands and hats. In the same way, from the rocky beach a mile outside the last house on the bay shore half a dozen girls had waved hats, hands, and *pareus* as we passed them. Speeded on our way with these farewells, we left the most hospitable people it has been my good fortune to meet.

A count of our acquisitions made on deck after leaving showed five sacks of taro, eighteen packages of the poipoi done up in leaves, nineteen boxes of taro and poipoi, fifteen bunches of bananas, twenty-two rabbits, and fourteen goats. While some of these had been purchased, the greater number were presents.

With a fair wind astern we lost sight of the precipitous mountain peaks in their enveloping fogs long before dark, but the memory of the happy days spent among the hospitable natives stayed in the foreground of our consciousness for some time.

# THE UNFORESEEN IN INDIAN VOCABULARY WORK

BY

C. HART MERRIAM *

THE task of collecting and verifying Indian vocabularies, sentences, and texts has many attractions, many surprises, and many disappointments. Nothing would seem easier than the setting down of words and sentences obtained in response to such simple questions as: "What do you call a black bear?" "What is the name of this basket?" and so on. But when one comes to check up his results by other Indians he discovers undreamed of possibilities. When, for instance, he finds that the expression recorded for *get up* means "it's morning," that the name received for a particular basket means "dirty old thing," that the word recorded for *black bear* is "blackberry," the word for *hungry*, "I guess I'll eat," and others equally startling, he is reluctantly forced to admit that words obtained from Indians do not always mean what they seem.

In the case of words that are the names of definite objects—as fire, water, sun, rain, snow, bear, coyote, eagle, and so on—errors rarely occur, but in other cases seemingly similar one must be on his guard. Thus in many languages the word given for the particular river or mountain near which the Indian resides is not its specific name but the general term used in a specific sense—meaning *the* river, or *the* mountain, it being the one uppermost in the speaker's mind. The same is true of the tribal name, for in California the word given in reply to the question, "What is the name of your tribe?" is in many instances the word for people—meaning *the* people. Thus the commonly accepted "tribal names" Mewuk, Midu, Nissenan, Patwin, Win, Wintoon, Yahnah, and Yokots are in each case—in the language of the tribe speaking—merely the word for *people*, meaning *the* people = our people.

Words expressing condition—as sick, well, kind, unkind, happy, lonesome, and a multitude of others—are particularly dangerous, as the answers are likely to be sentences instead of single words.

Indians, like ourselves, often have several words for the same thing. It is important therefore to ask for additional words of the same meaning; otherwise, in comparing vocabularies from Indians of the same tribe, one may be misled by different words to suspect the existence of another dialect.

It appears, therefore, that however honest and well-meaning an informant may be, a vocabulary—and still more emphatically a collection of sentences—should be looked upon with suspicion until verified. If this is impossible, as when the informant is the only survivor, it is well worth while to go over the ground with him a second time, after a lapse of months or years. In this way, many errors are corrected.

In the course of work of this kind one has many interesting, many curious, and some exasperating experiences. Some Indians are naturally suspicious and avoid giving direct answers. Others feel that you would not ask directly and boldly for the answer you really want, but that your question should be taken as suggestive; so, after due consideration, you are given an answer which the Indian's imagination pictures as conveying the desired information—howsoever wide it may be from the word or expression you are seeking. Hence it is not to be wondered at that the reading of a vocabulary or text to another person of the same tribe nearly always results in startling discoveries.

*Research Associate, Smithsonian Institution (E. H. Harriman Fund)

# DECREASE OF FUR-BEARING ANIMALS IN ALASKA

BY

E. W. NELSON*

THE fur-bearing animals of Alaska form one of its most valuable natural resources. For a number of years, however, the fur bearers in that territory have been destroyed to such an extent that their future is seriously endangered. Since the development of black-fox farming, the practice of digging out the dens of foxes has been followed to such an extent that these animals have become almost extinct over considerable areas.

The den-hunter locates a den containing young foxes and then digs it out, taking any black or cross fox pups it may contain and abandoning the others. The freshly turned earth and disturbed condition of the surroundings frighten away the mother fox, with the result that the young, abandoned by the hunter and by their parent, are left to perish. It is also reported that many of the black and cross foxes which are taken from dens ostensibly for breeding purposes are merely held in pens until their skins become prime the following fall or winter, when they are killed.

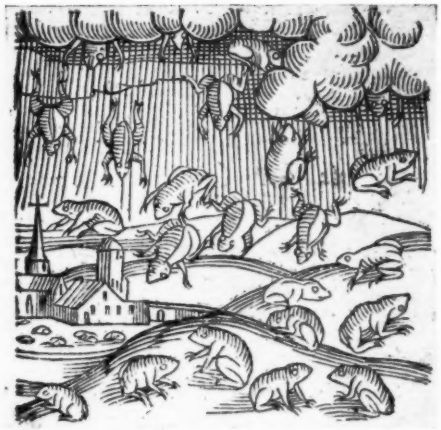
In addition to this, the illegal use of poison has been continued by a considerable number of unscrupulous trappers, thereby intensifying the destruction, which over great districts amounts to virtual extermination of all the fur bearers. . In some districts beaver houses have been opened in winter and the entire beaver colony killed for the skins.

This practice, combined with the intensive trapping encouraged by the exceedingly high prices of furs during the last few years, has greatly reduced the number of Alaska fur bearers. It is only by more adequate laws and a larger and more effective warden service that this depletion can be stopped. It is to the credit of many Alaskans that throughout the territory there is bitter antagonism over the killing of fur-bearing animals by the destructive methods mentioned above. At the same time there is no way of adequately controlling the evil under present conditions.

Owing to the fact that marten and beaver were seriously over-trapped and were in danger of extermination in large districts, several years ago, at the request of Alaskans, regulations were issued prohibiting the taking of beaver and marten over a considerable period in order that the country might be restocked. Such restocking had taken place in some districts, where these animals have been unmolested, but through connivance of unscrupulous persons, many trappers, particularly Indians, have been encouraged to trap illegally great numbers of both beaver and marten, and a large illicit traffic has been maintained in the skins of these animals. Numerous seizures of such skins have been made, but with the limited means available it has been impossible to stop the traffic, which persists because of the great profits involved. The demand for furs is so great that, with ordinarily high prices prevailing, the future of our fur bearers is seriously jeopardized unless stringent protective laws with proper limitations on the trapping season are made effective.

During the winter of 1919-20 one of the wardens of the Biological Survey made a round trip of about three hundred miles through a part of Alaska where foxes were once numerous, and saw the tracks of but one fox. Den-hunting and poison had cleaned them out.

*Chief, Bureau of Biological Survey, U. S. Department of Agriculture



# RAINS OF FISHES AND OF FROGS

BY

E. W. GUDGER*

WHEN my paper on "Rains of Fishes" was presented to NATURAL HISTORY,[1] I was asked if I could not furnish illustrations, and in reply I could only answer that the paper gave all the known accounts and that, so far as I knew, there were no such illustrations in existence. At that time I was actively searching, in an entirely different connection, for a curious and rare old book by a learned Alsatian named Conrad Wolffhart, who, in accordance with the fashion of his time, Hellenized his name into Conradus Lycosthenes Rubeaquensis. This book, *Prodigiorum ac Ostentorum Chronicon*, was published at Basel, Switzerland, in 1557.

No copy could be found in New York, nor was it in the Library of Congress. However, it was located in the Surgeon General's Library and application was made for its loan only to bring the answer that the book was too rare and irreplaceable to permit its being taken from the building. Later, by chance, a copy of this book was located in the Boston Public Library and the authorities there very kindly sent it down for my use. It arrived at the American Museum on the very day that the issue of NATURAL HISTORY containing my article on "Rains of Fishes" went to press.

On looking through this very interesting old tome I found one account of a rain of fishes and two accounts of rains of frogs, with illustrations, reproduced above, of both phenomena.

Lycosthenes tells us on page 367 that in the third year of the reign of Otho, the sixth emperor of that name (the year being 689 A.D.) there were tremendous meteorological disturbances, culminating apparently in a downpouring from heaven of little fishes in Saxony, this same downpour being illustrated by the figure reproduced above, it being, so far as known to me, unique.

With regard to the rain of frogs, our old author tells us on page 458 that in 1345 "rain mixed with frogs" fell in Germany. This phenomenon he illustrates with the very quaint figure here given—likewise the only one of its kind known to me. Again, on page 604, Lycosthenes tells us that in 1549, near the town of Colmar in upper Alsace, toads and frogs fell from heaven in such abundance that people killed them with clubs, and that later their dead bodies so infected the air that the authorities had them collected and carried away.

*Associate in Ichthyology, American Museum

[1]Gudger, E. W., "Rains of Fishes," NATURAL HISTORY, 1921, Vol. XXI, pp. 607-19.

# NOTES

## ASIA

In the midst of his duties as head of the Third Asiatic Expedition, Roy Chapman Andrews has found time to prepare a full account of activities in China, which will be featured in an early number of Natural History. In the meanwhile, his letters contain encouraging reports of the three groups of field workers there.

Of the two natives that remained in Shensi to continue the hunt for takin, Mr. Andrews writes on December 20:

"Last night my two hunters got back from Shensi. They got three more fine takin, one bear, one serow, one deer, one wild boar, and about two hundred small mammals—a really remarkable job. This gives us five splendid takin and insures a stunning group. This species has been shot by only about ten or twelve white men and is an exceedingly rare and difficult animal to get."

Mr. Clifford Pope has completed a two months' trip along the Yangtse River, where a fine collection of fish, reptiles, and batrachians, numbering about 4000, was secured, and is now collecting in the Tung Ting Lake district of Hunan. In his letter of January 1 Mr. Andrews reports:

"Pope has just telegraphed me from the Tung Ting Lake (Hunan) that he has a fine specimen of the remarkable porpoise described by Miller. . . . He called it *Lipotes* and it is really a 'living fossil.' Pope also has another fresh-water porpoise from the lake which must be new. These are really splendid acquisitions."

Although no report has been received from Mr. Granger, the fact that he is remaining for so long a time in Wauhsien where he located fossil "mines" late in October would indicate that these mines are yielding results.

Both in New York and in Peking preparations are under way for the Mongolian trip, which will occupy the spring and summer months. Mr. S. Bayard Colgate, in charge of motor transportation for the expedition, left New York on January 31 to sail from San Francisco February 7 on the "Empire State." He took with him the spare parts and other equipment required for the expedition's trucks and motors, including an important gift of tires and inner tubes presented by the United States Rubber Company. In March, he will be followed by Mr. J. B. Shackleford, motion picture photographer, who will reach Peking about April 1, in time to accompany Mr. Andrews into Mongolia. Professor C. P. Berkey, of Columbia University, is already *en route* to China where he will outline geological work. Until these men arrive from America, it will be necessary for Mr. Andrews to remain in Peking, where he is buying and packing supplies, equipment, and food, establishing stations in Mongolia and completing the detailed plans for the summer's work.

Unsettled conditions in Mongolia, where the "Red" government is in charge of Urga and the surrounding country, will make it advisable to secure assurances from the "Reds" that the party will not be molested. Mr. Andrews had feared that he would have to go in person to Urga, an unpleasant trip across the desert in midwinter, in order to make definite arrangements with the "Reds." However, in his last letter he says:

"The American Consul at Kalgan has gone to Urga in our behalf to see the 'Red' commander in Mongolia and the prospects are that arrangements will be made to obtain 'Red' protection so that we may use Urga as a base. If not, we shall establish a base right out in the center of Mongolia away from 'Red' influence."

## SOUTH AMERICA

Messrs. G. H. H. Tate and Geoffrey Gill, members of the American Museum expedition that under the leadership of Mr. George K. Cherrie has been collecting birds, mammals, and reptiles in Ecuador, have returned to New York, where they arrived on January 14, a few weeks after the home-coming of their invalided chief. They brought back with them a large number of specimens—2000 birds, 300 mammals, and 700 reptiles and amphibians—collected during their sojourn of six months in Ecuador.

It was Mr. Tate who accompanied Mr. Cherrie from the scene of his accident to Guayaquil, giving him such aid as he could on that nerve-testing trip. Subsequently he rejoined Mr. Gill and together they continued collecting. During the close of their sojourn they took a trip to the island of Jambele, off Puerto Bolivar, primarily to collect sea birds. Owing to the fact that the wind died down prematurely, they did not reach the island until an hour after sunset and were obliged to carry everything to shore, wading through water up to their waists. In this way they conveyed from shipboard their ten boxes and then, with the idea of placing them out of reach of the tide, carried them inland a quarter of a mile.

Jambele is a low-lying island, fringed with mangroves, intersected with tidal channels, and muddy in the extreme. To protect their possessions and to secure a dry foundation for their tent, the two collectors erected a platform of drift wood. This amphibious existence, which Messrs. Tate and Gill endured for several days, proves as attractive to sea birds as it is uninviting to man. Large numbers of these birds congregate at the island. A few land birds were also observed. Although few mammals were in evidence, one or two species of lizards were common on drift wood.

## AMPHIBIANS

For over half a year a pair of *Ascaphus*, North America's only discoglossid frog, have

A "tailed" frog that frequents icy streams at high altitudes in the Olympic Mountains

lived in a special terrarium in the department of herpetology, American Museum. This species, perhaps the most primitive batrachian in the world, is found only at high altitudes among the Olympics and certain other western mountains. It frequents "dashing streams, snow-fed and spring-fed, seldom more than a foot or so wide and a few inches deep." An expedition sent out during 1920 by the University of Michigan reports that:

"Collecting in these creeks was an arduous task; they were very swift, with many falls and miniature rapids, filled with rocks, with great tangles of devil's club and fallen trees along their banks, and the water was extraordinarily cold, usually under 40° even on the warmest days.

"It was under the rocks in these little creeks that *Ascaphus* lived. . . .

"A low temperature and cold water are evidently necessary for the welfare of the species, for they died very quickly when placed in the sunlight. By putting fresh ice water on them at short intervals we were able to bring two, collected August 8, to Michigan alive. They lived in an ice box until September 11, when they were preserved. They refused to eat in captivity."

The live pair in the Museum are the only survivors of a large series of *Ascaphus* secured in August of last year from the Olympic Mountains. All of the frogs in the shipment were kept alive during transit in a device permitting ice water to drip on them continuously. In a similar device a number of specimens were retained alive in the laboratory while suitable studies were being made of them for exhibition purposes. The two specimens mentioned have maintained good health since their arrival last August although it has been necessary to feed them forcibly.

*Ascaphus* shows in its organization its basal position among the frogs and toads. It is unique among these in possessing in the tailless adult two "tail-wagging" muscles homologous to similar muscles in the salamander's tail. The so-called "tail" shown in the picture of the male *Ascaphus*, reproduced herewith, is a specialized cloacal structure having no relation to the vertebral column or the tail muscles just referred to. A series of morphological studies on *Ascaphus* have been commenced by the department of herpetology. The first contribution will appear soon in the *Bulletin*.

## FISH

THE exhibit of deep-sea fish, including several that are luminous, is now undergoing an overhauling but will in the near future be reinstalled on the second floor of the American Museum. These fish are arranged in a dark compartment, where the absence of light represents an approximation to the conditions prevailing in the sunless depths of the sea in which the life of these fish is spent. Under these conditions the luminescent organs of the fish, represented in the exhibit by tiny, electrically lighted surfaces, show clearly and convey an impression of the appearance of these fish under natural conditions. Intermittently, however, the compartment containing this exhibit is lighted completely so that the visitor may view the fish in detail, their peculiar conformation revealed and not merely obscurely outlined by the dim lumination supplied by their own light organs.

## PUBLIC EDUCATION

"TEACHERS' DAY," January 20, the faculty and members of the graduating class of the New York Training School for Teachers were the guests of the American Museum. They assembled at 2 o'clock in the auditorium, where President Henry Fairfield Osborn delivered an address of welcome and impressed upon the visitors the importance, as well as the opportunities, of the teaching profession. Mr. George H. Sherwood, curator of the department of public education, presented a short history of the Museum and specified the ways in which the Museum is prepared to coöperate with the schools. To illustrate how Museum slides may be used in teaching, he then gave a specimen talk on glaciers, with special reference to the accompanying slides. Dr. G. Clyde Fisher, associate curator of the department, demonstrated the potentialities of the Museum's

series of moving pictures by delivering a talk, with film accompaniment, on "The Why of a Volcano." In furtherance of the same purpose, Mrs. Ruth Crosby Noble, assistant curator of the department, gave an explanatory talk while presenting a reel showing how the various exhibits of the American Museum are prepared, involving glass-blowing (illustrated by the model of *Synura*, on p. 90 of this issue), the reassembling of the bones of extinct animals for the palæontological exhibits, and other activities of the Museum's department of preparation.

The guests were then divided into groups and conducted by members of the Museum's staff through those exhibition halls of the Museum that are of greatest interest in connection with elementary school teaching and through the offices of the department of education, where they familiarized themselves with the routine to be pursued in obtaining Museum material for classroom use. At 4 o'clock the groups were reassembled in the hall of the Age of Man, where tea was served. Abundant evidence was given the prospective teachers that large as is the Museum, it is an approachable institution, faithful to its triple ideal of service—for the people, for education, for science.

## PUBLIC HEALTH

THE collection of living bacteria, which under the able supervision of Prof. C.-E. A. Winslow has been so interesting and valuable a feature of the department of public health, American Museum, is being transferred to Washington, where it will be maintained by the Society of American Bacteriologists, an organization peculiarly fitted to take over the custodianship.

This collection has been built up to a total of 655 different organisms; it includes nearly every well-defined type of bacteria now known; it is the only collection of its kind in this country. The opportunity for public service which it offers can scarcely be overestimated. It was the policy of the Museum, not only to maintain the cultures in good condition, but to send subcultures, free of charge, to properly qualified workers in the field of biology. Since the collection was established more than 26,000 cultures have been made available in this way and more than 700 different institutions have been served. For the most part the cultures have been distributed among institutions in this country, but more distant points in England, South Africa, South America, and Japan have also had their requirements satisfied.

REMOVED as we are by 3000 miles or more from the suffering into which Europe has been plunged in these days of food scarcity, depreciated currency, bad transportation facilities, and political uncertainty, it is not easy to realize the conditions obtaining in some of the more afflicted centers of the Continent, nor to measure the help that American dollars, expended under the wise supervision of the American Relief Administration (Herbert Hoover, Chairman), have been to impoverished populations faced with starvation.

An exhibition setting forth the work of that Administration in feeding the children of Vienna, and including charts, diagrams, and other material illustrative of a system of nutrition established under the direction of Dr. Clemens Pirquet, was held in the hall of forestry of the American Museum during the first two weeks of January. One of the features of the exhibition was a fine series of illuminated and decorated messages and resolutions of thanks coming from many public bodies and schools in Austria. Children participated in the ornamenting of these testimonials, thus showing their appreciation of the help given them.

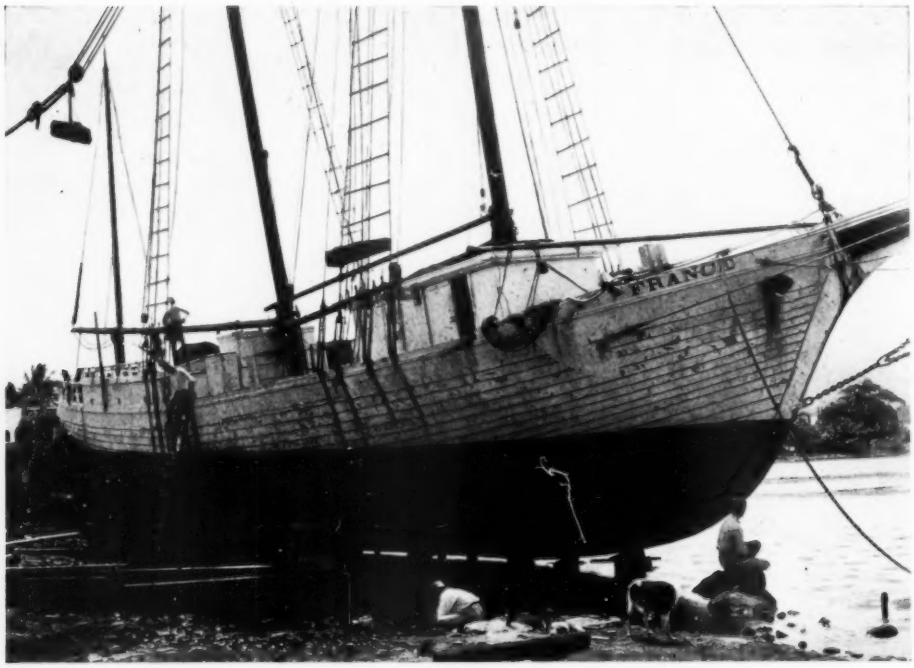
## BIRDS

REFERRING to the appreciation of Dr. Joel Asaph Allen which President Henry Fairfield Osborn wrote for the issue of NATURAL HISTORY for September-October, 1921, Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology of the University of California, writes:

"It is a very just appreciation of a man whose great influence, I wish to point out, did not stop within the walls of the American Museum, nor within the confines of the Atlantic states.

"Of all the eastern ornithologists active during the past thirty-five years I believe that Dr. Allen wielded the greatest influence in the field of serious scientific ornithology out here on the Pacific Coast. It was through the columns of *The Auk*, especially in the review department of that journal, that Dr. Allen exercised this influence. I think others of the younger bird students here in the West would agree with me that our conceptions in systematic zoölogy and geographical distribution were molded more importantly by reason of Dr. Allen's sane criticisms and comments in his various reviews than through what we read in other articles and in books covering the same ground. I know that this was true in my own case."

MR. JAMES P. CHAPIN, assistant curator of African birds, has recently returned to the American Museum after an absence of several months in Europe. Mr. Chapin has in preparation a report on the birds of the Belgian Congo, represented in the collections of the Museum by no less than 6500 specimens. This paper will appear in the *Bulletin* of the American Museum. One of Mr. Chapin's objects in visiting Europe was to study, for purposes of comparison, the collections of birds of the Congo and adjacent regions in the museums of the Continent and of England. Everywhere he received a cordial welcome, as well as every facility for study, and was invited to attend meetings of both the British




This substantial ship has been acquired by the Whitney South Sea Expedition and will make possible even greater accomplishments than those that the expedition already has to its credit

Ornithologists' Club and the German Ornithologische Gesellschaft. There has been considerable progress in Congo ornithology since the publication, nearly two decades ago, of Dr. Anton Reichenow's notable work on the birds of Africa (*Die Vögel Afrikas*). Mr. Chapin's prospective publication, based on field work in the Congo extending over five and one half years and supplemented by intensive study of the birds collected, will mark an important forward step in the knowledge of this varied tropical fauna.

THE acquisition of the "France" by the Committee of the Whitney South Sea Expedition, augurs well for the rapid expansion of the American Museum's investigations in Polynesia. During the first year's work, the purchase of several other schooners had been considered, but each time the matter was deferred until Mr. Rollo H. Beck, in charge of the field work, felt that he had found a vessel which suited all the requirements for collecting among the half-charted archipelagos of the southern Pacific.

The "France" is a schooner of 75 tons, with an auxiliary 60-horse-power engine. She was built at Tahiti about three years ago, and is, of course, of French registry. The French authorities in Polynesia, with characteristic courtesy, have waived the usual requirement of partial French ownership and have permitted the Museum to navigate the vessel under the tricolor and with a partly native crew.

About February 1, Mr. Beck sailed southward from the Society Islands in the "France" in order to avoid the hurricane season of the trade-wind belt. He hoped on this expedition to go as far eastward as Ducie and the Pitcairn Islands before returning to Tahiti.

Recent shipments from the field workers of the expedition include important collections of plants and reptiles, and several hundred birds from the Marquesas Islands and various islands of the Paumotu group, together with more than 2000 pages of manuscript notes written in the field by Mr. Quayle.

## INSECTS

AMONG the beautiful things that meet the eye of a European who crosses the Atlantic are, and doubtless have been since the earliest voyages, the scintillating fireflies of summer. Though found from Canada southward, they become more noticeable in the West Indies because the common species are larger, more brilliant, and emit their light during a greater part of the year. The American Museum's expeditions during recent years have visited many West Indian islands, and hundreds of fireflies, representing many new species as well as nearly all that were

previously known, have been among the specimens thus added to the Museum's collections. It has been a long task to compare these specimens with others obtained from England, France, and elsewhere, and determine which were new; the result, however, shows that of one hundred eighteen species now known, thirty-eight have been discovered through expeditions and studies conducted by the American Museum. The greatest interest really attaches to the extraordinary little creature found in the mountains of Porto Rico, christened *Leptolycus heterocornis*, the characters of which revealed not only a new species but a new genus and a new tribe. The minute studies with the microscope by Mr. A. J. Mutchler, assistant curator of the department of entomology, also disclosed in specimens from the little island of Montserrat morphological characters heretofore unknown in insects, the use of which still remains a mystery. "The Lycidæ, Lampyridæ, and Cantharidæ (Telephoridæ) of the West Indies" by Charles W. Leng and Andrew J. Mutchler is the title under which the results of these studies on the beetles commonly known as fireflies and some allied beetles which do not emit light, will appear in an American Museum *Bulletin*.

IN DELIVERING his address as president of the American Association for the Advancement of Science at the annual gathering in Toronto, Dr. L. O. Howard, Chief of the Bureau of Entomology, laid emphasis on the rôle of the insect as the strongest rival of man on this planet and on the need of a trained army of biologists—thousands of them—to wage successful warfare against the myriads of these tiny combatants that rob man of his food supply or, as disease carriers, threaten his life. Many of the most deadly instruments of destruction that man used in the recent World War have already been turned upon the insect hordes. Army flame throwers have been used against the swarms of locusts in the south of France; certain of the war gasses have been tried out as destroyers of insects; the aëroplane has been used for reconnaissance in connection with the pink bollworm along the Rio Grande, for locating beetle-infested timber in the forests of the Northwest, and even for insecticidal dusting of dense tree growths in Ohio.

Happily for man there is internecine strife in the insect world as well as in the human. Said a distinguished physicist recently to Dr. Howard: "If they would quit fighting among themselves, they would overwhelm the whole vertebrate series." Those insects that fight injurious species are the allies of man and in utilizing them in threatened areas, man finds one of his best weapons of defense. Dr. Howard, in closing, quoted a striking passage from Maeterlinck:

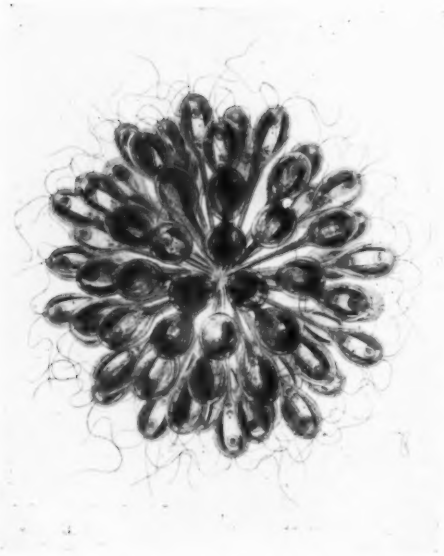
"The insect does not belong to our world. The other animals, even the plants, in spite of their mute existence and the great secrets which they nourish, do not seem wholly strangers to us. In spite of all, we feel with them a certain sense of terrestrial fraternity. They surprise us, even make us marvel, but they fail to overthrow our basic concepts. The insect, on the other hand, brings with him something that does not seem to belong to the customs, the morale, the psychology of our globe. One would say that it comes from another planet more monstrous, more energetic, more insensate, more atrocious, more infernal than ours. . . . It seizes upon life with an authority and a fecundity which nothing equals here below; we can not grasp the idea that it is a thought of that Nature of which we flatter ourselves that we are the favorite children. . . . There is, without doubt, with this amazement and this incomprehension, an I know not what instinctive and profound inquietude inspired by these creatures, so incomparably better armed, better equipped than ourselves, these compressions of energy and activity which are our most mysterious enemies, our rivals in these latter hours, and perhaps our successors."

## MAMMALS

A CONSUMMATE achievement in the art of taxidermy as perfected by Mr. Carl E. Akeley is the African elephant group recently placed on exhibition on the second floor, east wing, of the American Museum. It represents the culmination of eleven years devoted by Mr. Akeley to its preparation, in the course of which time he invented an entirely new method of mounting, which is exemplified in this group. The group consists of a young elephant, flanked on one side by a female and on the other by a large male with ears spread wide and trunk extended Covering the rear is another bull elephant with ears similarly spread. The female was secured especially for this group by Colonel Roosevelt during his African expedition of 1909 and was shot while charging. The little one was shot by Mr. Kermit Roosevelt south of Mt. Elgon. The two male elephants were taken by Mr. Akeley near Mt. Kenia earlier in the same year. This splendid group will ultimately occupy the center of the projected African Hall, which will form part of a section of the American Museum to be erected as a memorial to Theodore Roosevelt. Plans for this hall, as well as for the groups illustrative of the animal life of Africa, have been prepared by Mr. Akeley.

AN INVITATION has been extended to the American Society of Mammalogists to use the American Museum for their annual meeting. It is comtemplated to hold this meeting early in May, if possible at the time when the New York Zoölogical Society formally opens its hall of heads and horns.

THE issue of NATURAL HISTORY for November-December, 1921, contained a picture of John



A colony of the microscopic organism, *Synura*, that recently imparted such a disagreeable flavor to the drinking water of New York City

Gorilla, which, not only because of the popular interest in the subject but in equal measure because of the convincing and natural manner in which the ape is mounted, was given an entire page. Through an unfortunate oversight the caption connected with the picture failed to give credit to the artist who planned and executed this piece of work. It was Mr. Frederick Blaschke, whose large groups, including the Pigmy camp in the Congo forest, the red ground monkeys, the horse-tailed monkeys, and the European boar, are well known to all who have visited the Museum.

## LOWER INVERTEBRATES

On account of the popular interest in *Synura*, the protozoan animalcule which has recently been spoiling the taste and odor of the drinking water of New York City, a glass model representing a colony of this organism, prepared by the department of lower invertebrates, was placed on special exhibition in the foyer of the American Museum in January and has attracted considerable attention. This is evidenced by the fact that on Sunday, January 15, when *Synura* was at the zenith of its effectiveness, 15,000 persons visited the Museum as compared with the average Sunday attendance of 5000. A colony of *Synura*, when fully grown, is composed of about fifty individuals, which radiate from a common center by slender prolongations of protoplasm, and measures about $\frac{1}{250}$ of an inch in diameter. It gives off an oily substance which spreads rapidly through the water, causing the fishy or cucumber-like taste that has proved so objectionable. A small quantity of such oil will affect a considerable quantity of water. Fortunately it is harmless. *Synura* is usually present in drinking water, but cannot be detected except at certain times when it multiplies with great rapidity. Its power of reproduction is well illustrated by the fact that the colony of fifty individuals may break up and each member may then become the starting point of a new colony of fifty or more individuals.

## MAN

Archæological finds of no little value are reported under recent date by Mr. Earl H. Morris, who is engaged in the excavation of the Aztec Ruin, New Mexico:

"A point of interest has just turned up here. I found a skeleton sticking out of the bank of Nelson's test pit in the southeast refuse mound, and with it two fine pieces of Chaco ware. Today I found another grave on the opposite side of the pit, also accompanied by the older pottery. It has always been very much of a puzzle where the Chaco people of this place put their dead, as only one skeleton identifiable as of this age has been found previous to these two. It now looks as if there may be quite a few in the southeast refuse mound. Of course, it has been pretty well prospected, but in the untouched parts there is room for scores of graves. I hope they prove to be there."

To the February issue of the *National Geographic Magazine* Mr. Sylvanus Griswold Morley, of the Carnegie Institution of Washington, has contributed under the title "The Foremost Intellectual Achievement of Ancient America" an excellent popular presentation of a very difficult subject. The men who have made the most important recent contributions to our knowledge of ancient civilization in Central America are the writer in question and Doctor Herbert J. Spinden, formerly associate curator in the department of anthropology, American Museum, and now of the Peabody Museum, Harvard Unversity. Mr. Morley gave his chief attention to the translation of inscriptions on monuments and the discovery of new inscriptions. In the latter he has been particularly successful and thus has added greatly to our knowledge of dated inscriptions and has consequently recovered for us a great deal of the early history of the Maya.

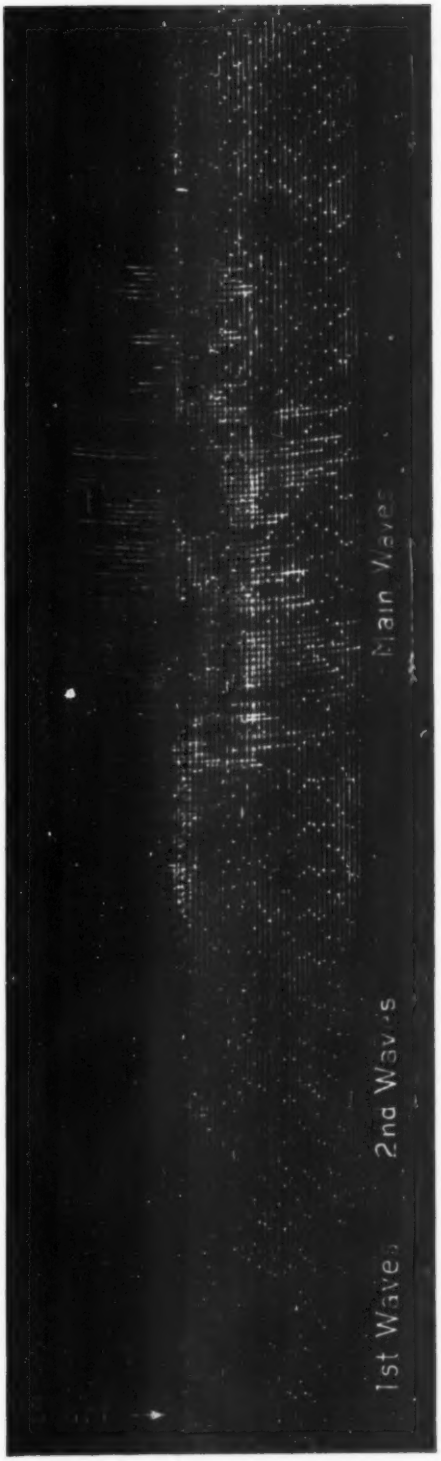
Doctor Spinden gave his chief attention to the development of Maya art, being able to establish broad chronological differences in art objects from the Maya and thus laying down a general chronology for the whole of Central America. This he was later able to supplement by conducting explorations for the American Museum, with the result that a general working scheme for the chronology of New World culture has been established.

## THE EARTHQUAKE OF JANUARY 31

ALTHOUGH on an average there are three earthquakes a day in different parts of the globe, it is only when an earthquake of cataclysmic proportions occurs that the general public takes cognizance of it. On January 31 of this year occurred an earthquake which, had it affected a populated section of the world, would have created as much havoc doubtless as did the great San Francisco earthquake of 1906. It was as violent as that disturbance but devoid of harm because it occurred on the floor of the ocean, in all probability about 600 miles northwest of San Francisco. It was caused, no doubt, by earth shiftings along the fault plane known as the Andreas rift, a rift that traverses the region of which San Francisco is a part, extends thence along the California coast, and links up with the site of the disturbance of January 31 by pursuing a northwest course. Thus the San Francisco disaster of 1906 and the earthquake of January 31, 1922, are related phenomena.

On the morning when the earthquake occurred an interested group gathered about the Mainka seismograph in the American Museum and watched attentively the violent fluctuations of the needle that indicated a disturbance of very great intensity and possibly one involving dire calamity for many human beings. While the earthquake was in progress, there was opportunity for speculation as to the place of its occurrence, for until data can be secured from two other widely separated recording stations, making triangulation possible, the location of a particular quake cannot be determined. The seismograph record, reproduced herewith, of the earthquake shows the two preliminary and the main waves. The more remote the site of the recording station from the scene of the disturbance, the greater is the distance on the record between the arrival of the first preliminary, the second preliminary, and the main waves. These facts are helpful to the observer in computing the distance intervening between the station and the scene of the quake.

It is to Mr. Emerson McMillin, a former president of the New York Academy of Sciences, that the public is indebted for the purchase and installation in the American Museum of the fine seismograph there in operation. On the day that the earthquake occurred President Henry Fairfield Osborn telegraphed to Mr. McMillin and received from him this cordial response: "For your thoughtfulness I feel deeply grateful. For those who have given their time and means to keep the seismograph in working order, I also feel grateful. I am glad to know that New York will occasionally take an interest in its own scientific facilities and does not have to depend on Cleveland, Georgetown, or some other small but enterprising city."




The record, from the seismograph in the American Museum, of the earthquake of January 31

## BUTLER'S PAINTING OF THE NORTHERN LIGHTS

MR. HOWARD RUSSELL BUTLER has on several occasions painted Bald Head Cliff near Ogunquit, Maine. One of these pictures, showing the scene by moonlight, won the Carnegie Prize in 1916. In August, 1919, the artist was revisiting the region and under the spell of its old-time appeal to him, decided to make one more nocturnal painting of the cliff. He set to work on his sketch, favored by a cloudless sky in which the "Queen of the Heavens" shone in full splendor. Mr. Butler had completed his foreground, and was resting, entranced with the scene, his sketch board and colors at hand, when the first light of an aurora borealis appeared. Seized by an inspiration, the artist immediately extended his sky, changing his picture from a horizontal to a vertical one, and had the good fortune of transferring to canvas a record of one of the most magnificent auroras that have ever been seen on the coast of Maine, where brilliant manifestations of the northern lights are frequent.

The result is the beautiful painting now on exhibition at the American Museum. A black and white reproduction of this picture appeared in NATURAL HISTORY for March-April, 1921 (p. 205), but the accompanying reproduction in color gives a better idea of the phantasmal beauty and sublimity of this phenomenon.

## FOSSIL VERTEBRATES

DURING the last few years the University of Toronto has secured a large collection of Cretaceous dinosaurs from the Red Deer River in Alberta and has under way what promises to be a very fine exhibit. Among the first specimens secured was a nearly complete skeleton of the *Kritosaurus*, or hook-nosed duck-bill dinosaur, a form first discovered in New Mexico, later in Canada. This skeleton was the subject of a very excellent monograph by W. A. Parks, professor of geology in the university, and is now handsomely installed in its great geological museum. Another fine skeleton found last summer is reported by Professor Parks to be a new genus related to the *Corythosaurus*, or helmet dinosaur, of which two fine skeletons are in the exhibit of the American Museum. All these dinosaurs of the duck-bill group are huge, bipedal reptiles, with long legs, hoofs on the feet, a flattened, horny beak suggestive of that of the ducks and geese, and cheek teeth fitted like those of modern horses or ruminants to grind the food. Finally, they had a powerful, flattened tail, resembling in this respect the crocodiles or other swimming reptiles. These facts prove that they were harmless vegetarians, admirably adapted to wading and swimming, and finding in their amphibious habits a refuge from the huge carnivorous dinosaurs that terrorized the land, while their habitat of fresh-water bayous and rivers protected them from attack by the fierce mosasaurs (gigantic marine lizards) that infested the open sea. Nevertheless, these duck-bill dinosaurs did on occasion venture out into the ocean, for their remains are occasionally found in true marine formations deposited at a distance from the land. No bones of any of the other kinds of dinosaurs have been found in the ocean sediments of the Cretaceous period.

The University of Alberta at Edmonton also has entered the dinosaur field during the past summer. It engaged Mr. George M. Sternberg, one of the best experts in dinosaur collecting, to take charge of an expedition to the Red Deer River. Mr. Sternberg secured a fine collection, including skeletons of the carnivorous and duck-bill dinosaurs, and a partial skeleton of a rare armored dinosaur, *Stegoceras*, hitherto known only from a fragment of the skull. With this auspicious beginning, the geological department of the university, under the direction of Professor John A. Allan, intends to continue and expand the dinosaur work as a leading feature of Alberta geology.

## EMILE CARTAILHAC

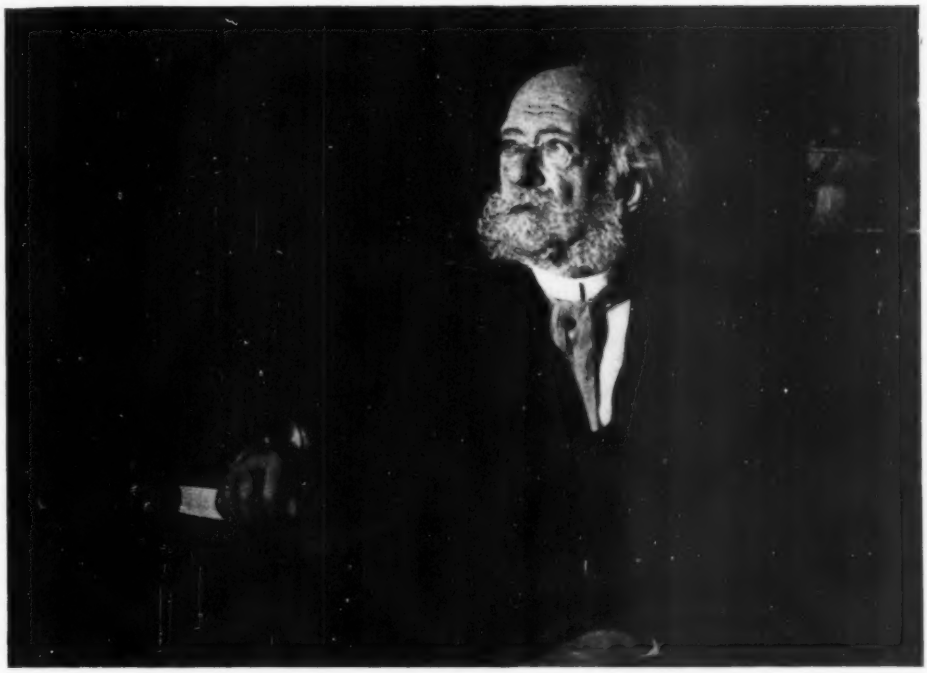
PROFESSOR EMILE CARTAILHAC, veteran archæologist of France and leader of the modern school, passed away at Geneva on November 25.

Readers of Professor Henry Fairfield Osborn's *Men of the Old Stone Age* will recall the photograph of Professor Cartailhac leading the way to the entrance of one of the caverns. The photograph on p. 93 gives an idea of his venerable figure but conveys little conception of his remarkable activity. Professor at the University of Toulouse for the past forty years, he found time not only to conduct excavations in all the archæological regions of southern France but also to contribute a series of splendid volumes and writings to the Memoirs of the Institut de Paléontologie Humaine and of shorter papers to the leading French journals of anthropology. One of his most popular works is *La France Prehistorique d'après les Sepultures et les Monuments*. Among his most learned contributions is his volume *Les Grottes de Grimaldi—Archéologie*. The Museum of Toulouse contains a delightfully arranged historic collection, the work of Professor Cartailhac. In 1913 it was Professor Osborn's great privilege to have Professor Cartailhac conduct him through the caverns of the Pyrenees region; in those most difficult to traverse as well as in those more easy of access he was alert and sure-footed and put to shame his less agile American companions. On the occasion of the discovery of the famous caverns near the residence of the Comte de Bégouen, Professor Cartailhac was called by telephone and arrived by the next train ready to take any risks to be the first to see the riches of the Tuc d'Audoubert and of Les Trois Frères. To express his

*Courtesy of University Society Inc.*

NORTHERN LIGHTS, MAINE COAST, AUGUST, 1919

From a painting by Howard Russell Butler



Emile Cartailhac, veteran archæologist of France, whose death occurred recently

appreciation, Professor Osborn dedicated his *Men of the Old Stone Age* to his "distinguished guides through the Upper Palæolithic caverns of the Pyrenees, Dordogne, and the Cantabrian mountains of Spain," of whom Emile Cartailhac was the first.

## ALESSANDRO FABBRI

ALESSANDRO FABBRI, research associate in comparative physiology in the American Museum, died of pneumonia on February 6. Mr. Fabbri was a many-sided man, one who, by nature a scholar, gave his energies to the pursuit of things of worth. Although a lover of music, art, and literature, it is through his scientific experiments that Mr. Fabbri will be remembered best —experiments which brought him into touch not only with the American Museum but also with the Rockefeller Institute. He was extraordinarily adept in micro-cinema photography. Some of his motion pictures reveal the behavior of organisms so minute that a drop of water suffices for the theater of their activities. In one of his films barnacles are shown, their fine, feathery appendages in motion, grasping for the food that may be floating within their reach. Another motion picture he secured is that of the embryo chick in the several stages of its development. In this film the beating of the chick's heart may be seen and, more marvelous still, the circulation of its blood even to the inclusion of the corpuscles.

Of all his micro-cinema photography, however, no single achievement was as great or of as far-reaching service as the series of pictures he took of living, growing tissue, thereby supplementing in an important way the research work that Dr. Alexis Carrel of the Rockefeller Institute has been doing in connection with such tissue. The loss that science has suffered in the death of Mr. Fabbri may be measured to some extent by the fact that it was his hope, had he lived, to devise means for obtaining a motion picture of the growth of a cancerous cell and its behavior during the application of radium.

Another interest of Mr. Fabbri was wireless telegraphy. The radio station at Otter Cliffs, Bar Harbor, Maine, which Mr. Fabbri erected, was used under his direction during the war as a link in the coastal patrol system. The efficiency of this station gradually won it a place of pre-eminence and before the close of the war and continuing throughout the negotiations for peace, the most important messages of the Government were transmitted through this station, no less than 110 operators being required for the work involved. Under Mr. Fabbri a new and much more effective system of receiving was developed, which, in justice to its originator, the Government wanted to call the Fabbri System, but with characteristic modesty Mr. Fabbri declined this honor, which he felt should be shared with those who had carried out his idea.

That the Government did not fail, however,

ALESSANDRO FABBRI

to take cognizance of the invaluable aid given by Mr. Fabbri is indicated by the citation accompanying the conferring upon him of the Navy Cross:

THE SECRETARY OF THE NAVY,
WASHINGTON, 11 November, 1920.

SIR:

The President of the United States takes pleasure in presenting the Navy Cross to

Lieutenant Alessandro Fabbri

for services during the World War as set forth in the following:

Citation:

For exceptionally meritorious service in a duty of great responsibility in the development of the radio receiving station at Otter Cliffs, Maine, and the small sending station at Sea Wall. Under Lieutenant Fabbri's direction, the station was developed from a small amateur experimental station, until at the end of the War, it was the most important and the most efficient station in the world.

For the President,
JOSEPHUS DANIELS,
Secretary of the Navy.

Early in 1910 Mr. Fabbri conducted a marine expedition in the interests of the American Museum, using for the purpose a boat, the "Tecla," which he equipped especially for the collecting of fish. At Miami Mr. John T. Nichols, of the scientific staff of the Museum, joined the expedition, which included, in addition to Mr. Fabbri and his brother Ernesto, an adequate force of men. For several weeks they cruised from Miami to Key West and thence up the west coast of Florida, obtaining a fine series of West Indian fish for the study collections of the Museum—a series which, consisting of about 200 species, several of them new to science, has been of constant use since.

## CONSERVATION

MR. H. E. ANTHONY, associate curator of mammals of the Western Hemisphere, American Museum, attended the annual meeting of the American Game Protective Association held at the Waldorf Astoria, December 12–13. He represented President Henry Fairfield Osborn and the American Museum at these meetings. The session was well attended by men from all over the United States and Canada, and among those present were many whose names have figured prominently in movements for the protection of wild animal life. Many state game commissioners and wardens presented outlines and reports of progress in according such protection, and the general sentiment of the congress appeared to be strongly in favor of the segregation of large areas to serve as game refuges and as public hunting domains when properly restricted. An idea which seems to be widely rooted and which would appear to be in need of some modification is that all predatory mammals must be greatly reduced in numbers, the reduction in some cases being tantamount to extermination. This condition is desired ostensibly to protect wild life, and, to an even greater extent, domestic stock. The consequences of any such deliberate upsetting of natural balances are so apparent, whether viewed from the standpoint of practical economy or from an æsthetic love of nature, that they may well bring to question the advisability of such measures. An area where all coyotes, wolves, bobcats, etc., have been extirpated might be a land of bounteous flocks to the sheep man, and yet be so overrun by jack rabbits and ground squirrels, deprived of their natural check, that it would be worthless to the ranch man.

MR. EDWARD L. PARTRIDGE has accepted the invitation of President Henry Fairfield Osborn of the American Museum and the New York Zoological Society to represent those institutions at the second Conference on State Parks that is to be held May 22–25 at Bear Mountain Inn, Palisades Interstate Park. The first Conference, which took place in Des Moines in January, 1921, gave a powerful impetus to the movement. New parks have been created and desired legislation has been enacted. With past accomplishments to stimulate it to new endeavors, the prospective Conference will take up its work, hopeful that in the not distant future all of the states of the Union may participate in the establishment of parks and that the slogan of "a state park every hundred miles from Maine to California" may become an actuality. The governor of each state is being urged to appoint an officia

delegate, or delegates, to the Conference and in addition various associations, interested either directly or indirectly in the state park idea, are invited to send their own representatives.

The place of gathering chosen for the Conference will afford the delegates an opportunity, in the intervals given to recreation, of seeing the development that has taken place in the Palisades Interstate Park. Among the excursions planned is a motor ride from the Bear Mountain Inn across the Hudson to Lake Kensico and from there down the Bronx River Parkway to the New York Zoological Park.

## CHARLES BASKERVILLE

IN THE death of Dr. Charles Baskerville, on January 28, 1922, the science of mineralogy lost a valued contributor and the science of chemistry a talented, brilliant, and indefatigable worker, one who was keen in research and also a great instructor. In the University of North Carolina (1891–1904) and in the College of the City of New York from 1904 up to the time of his death, he gave constant proof of his devotion to science.

He was versatile, enterprising, industrious, and of a splendid physique. He was a good speaker, which made him a good lecturer, and he presented his papers with remarkable terseness. As a chemist, he had an unusually broad vision. In addition to his work on anæsthesia, he treated of chemistry as applied to occupational diseases, and did most important work in the study of the rare earths. But of special interest to the American Museum were his researches in phosphorescence and radio-activity, for these two fields of investigation brought Dr. Baskerville into immediate contact with that institution.

About 1903, a variety of spodumene was identified as new by the writer, and it was his intention to name it after J. Pierpont Morgan. It was, however, impossible to get in touch with Mr. Morgan at that time, and Dr. Baskerville then named this mineral after the writer.[1] It responded to the ultra-violet rays, the Roentgen rays, radium, polonium, and actinium.

At that time an extended investigation of certain optical properties of the gem-minerals in the American Museum was in progress. To have moved all these minerals, 15,000 in number, to a dark room would have been a laborious task and would have meant disarrangement of this magnificent collection; furthermore, there was the danger of breaking and abrading many of the exquisite and delicate crystals, which are the feature of the collection. Therefore, an apparatus was devised on a moving stand, and the various substances were brought in direct contact with the radiations. A thorough investigation was made in the latter part of July and in August, Dr. Baskerville and the writer

[1] *Am. Jour. Sci.* Vol. XVI, 1903, p. 265; Baskerville, *Science*, Vol. XVIII, Sept. 4, 1903, pp. 303-304.

CHARLES BASKERVILLE

devoting more than twenty nights during these months to the task.

Dr. Baskerville, not only by his own researches but also and especially by developing and equipping what was perhaps the best series of chemical laboratories in the United States, and by organizing a department which has given tuition to hundreds of young men preparing themselves for service in this science, made his lasting contribution, though his studies and researches and teachings here are over.—GEORGE F. KUNZ.

## TROPICAL RESEARCH STATION

A FINE series of water-color pictures of animals painted from nature by Miss Isabelle Cooper of the Tropical Research Station of the New York Zoological Society, at Kartabo, British Guiana, were recently on exhibition at the American Museum. Many of these pictures have figured as colored lantern slides in the lectures of Mr. William Beebe, the director of the Station. They include a variety of subjects: reptiles, striped, spotted, or with scroll-like markings, spiny backed as well as smooth; insects of grotesque shape, some with leaflike appendages on the third pair of legs; fishes of brilliant hue and birds of fine plumage, as well as several interesting studies of bats. Not only are the creatures represented in their entirety but in many cases enlargements have been made of special parts, such as the head and forequarters. The eyes of a number of reptiles, brilliant pools of variegated color, are depicted in this way and serve as records of the appearance of the organ in life, the pigmentation being altered in death. One picture shows a parasitic wasp alighting on a caterpillar. The victim is writhing in its vain

efforts to throw off the tiny flier, which is presumably about to thrust its sting into the caterpillar and deposit its eggs.

In addition to the pictures arranged about the walls, the room devoted to this exhibit contained two cases. In one of these were gathered some of the larger publications that have resulted from the researches of the Station; in the other case, sample lithographic reproductions of the paintings shown. The New York Zoological Society will publish these reproductions from time to time in portfolios of one hundred, together with the life histories of the animals depicted.

## INSTITUTE FOR RESEARCH IN TROPICAL AMERICA

At a recent meeting of the institutional representatives of the Institute for Research in Tropical America, Dr. A. S. Hitchcock of Washington was elected chairman of the Executive Committee and Dr. Alexander G. Ruthven of the University of Michigan, secretary and treasurer. Dr. Henry E. Crampton, until recently honorary curator of lower invertebrates in the American Museum, was elected vice chairman. He is succeeded in his functions as representative of the American Museum in the Institute for Research in Tropical America by Dr. Frank E. Chapman, curator of the department of birds.

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Since the last issue of Natural History the following persons have been elected members of the American Museum:

*Benefactors:* Messrs. George F. Baker and Ogden Mills.

*Associate Founders:* Messrs. Charles Lanier and Harry Payne Whitney.

*Associate Benefactor:* Mr. John D. Rockefeller, Jr.

*Patrons:* Mrs. Clement Acton Griscom; Messrs. George F. Baker, Jr., George J. Baldwin, Charles L. Bernheimer, and Frank J. Myers.

*Fellows:* Mrs. Charles L. Bernheimer; the Honorable Recaredo Amengual; Messrs. Murray Guggenheim, S. R. Guggenheim, Dwight W. Morrow, and John T. Pratt.

*Life Members:* Mesdames E. H. Danforth, Lawrence L. Tweedy; the Misses Elizabeth Vernon Bronson, Isabel Rogers Edgar; Lieutenant Harry F. Guggenheim, U.S.N.; Messrs. Edgar B. Bronson, Jr., Barnum Brown, George Agnew Chamberlain, A. K. Haagner, T. W. Lamont, Mengo L. Morgenthau, H. Obermaier, Harper Silliman, Ludovic Soderstrom, and Irving K. Taylor.

*Sustaining Members:* Mesdames Frederick Lewisohn, George W. Mann; Miss Cornelia K. Manley; Messrs. Jesse Metcalf and George Whitney.

*Annual Members:* Mesdames Reginald Barclay, Richard S. Barnes, Charles F. Berger, Hans Bernstorff, Cordelia Biddle Duke, C. D. Fraser, J. M. Goetchius, H. Van Rensselaer Kennedy, John H. Mohlman, Joseph Parsons, Armistead Peter, 3d, James R. Steers, Thomas Thacher, Augustus Van Cortlandt, Annie M. Webster, Morris Wilkins; the Misses E. W. Calkins, M. Louise Dixon, Ada Thurston, Alice I. Wright; Doctors Joseph A. Blake, Louis Casamajor, John F. Erdmann, Harry Greenstein, Leo Mayer, Belle Thomas, Norman E. Titus, Ira S. Wile; the Reverend Eliot White; Messrs. Robt. Breckenridge Baird, Joseph U. Blanchet, Walter E. Cooke, John P. Crozer, Lyttleton B. P. Gould, Frank J. Hermes, Louis Hewlett, F. Burrall Hoffman, Jr., Wm. H. Osborn, Charles F. Park, Jr., Joseph M. Proskauer, Franklin Remington, F. Bayard Rives, Irving Bruce Roberts, Alfred L. Rose, Ernst Rosenfeld, William Lapham Saunders, Eustace Seligman, Simon T. Stern, Walter H. Sykes, Jr., Edward R. Tolfree, N. L. B. Tweedie, Maurice Veit, Charles J. Werner, James E. West, Travis H. Whitney, William Whitney, Howard Whittemore, Arthur R. Wilcox, Arthur E. Wood, P. D. Wright, Master Robert Korn, and the Friends School.

*Associate Members:* Mesdames Eugene S. Bristol, Ernest A. Bryant, Walter Clothier, Alice E. D. Goudy, Charles D. Willits; the Misses M. Catherine Allen, Florence S. Boro, E. A. Corning, Maria Louise Grouard, Caroline M. Wheeler; Doctors Robert G. Le Conte, James G. Needham, Daniel A. Tovar; the Rev. J. A. Alexander, the Rev. A. P. Corman; Professors Thomas Chauncey Carter, Percy E. Raymond; Messrs. Walter G. Albrecht, Ivan W. Baker, James F. Ballard, James H. Bunce, Narciso Rabell Cabrero, Brighton C. Cain, Kenyon Chamberlain, John A. Clark, Joseph B. Davison, H. C. Denslow, W. E. Doyle, Austin Dunham, Donald Hume Fry, Jr., George J. Gnau, Charles Theodore Greve, Harry Peale Haldt, Leonard D. Hardy, Philip C. Heald, John L. Hollingshead, William A. Ingram, Walter M. Jackson, Sheldon Q. Kerruish, H. R. Kimes, E. J. Kraus, Fred Lange, Earl Larrabee, J. H. Longstreet, P. G. Loxley, R. A. Morris, Jr., Edward G. Mullen, Frank Chauncey Patten, Wm. J. G. Prest, W. E. Richardson, W. C. Rock, Jas. A. Sellards, Jr., W. O. Shultz, Morton Snyder, James C. Stevens, Allen C. Tester, Arthur Thacher, John W. Tryon, Edw. C. Uren, Alex. Walker, and W. O. Whittle.